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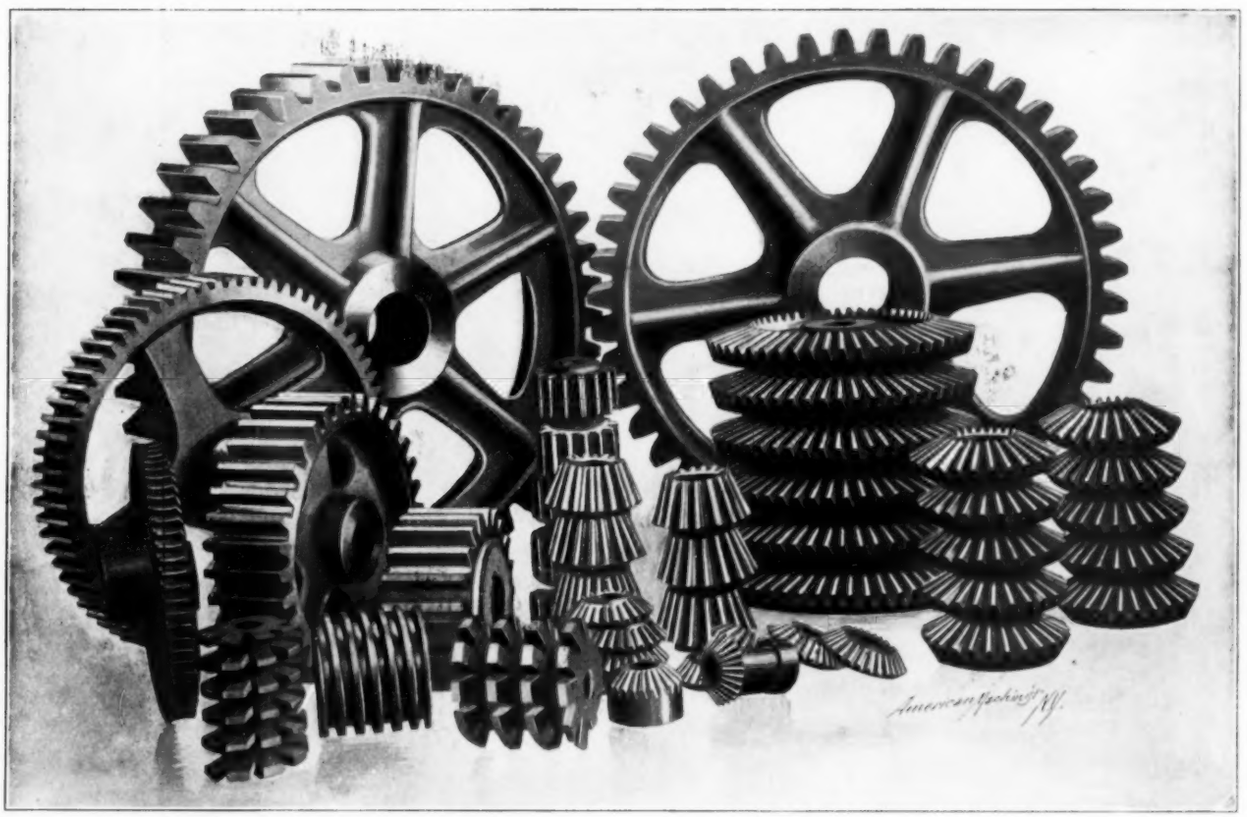
Index to Advertisers and Classified Index Following Reading Matter.

CORRECTLY CUT GEARS



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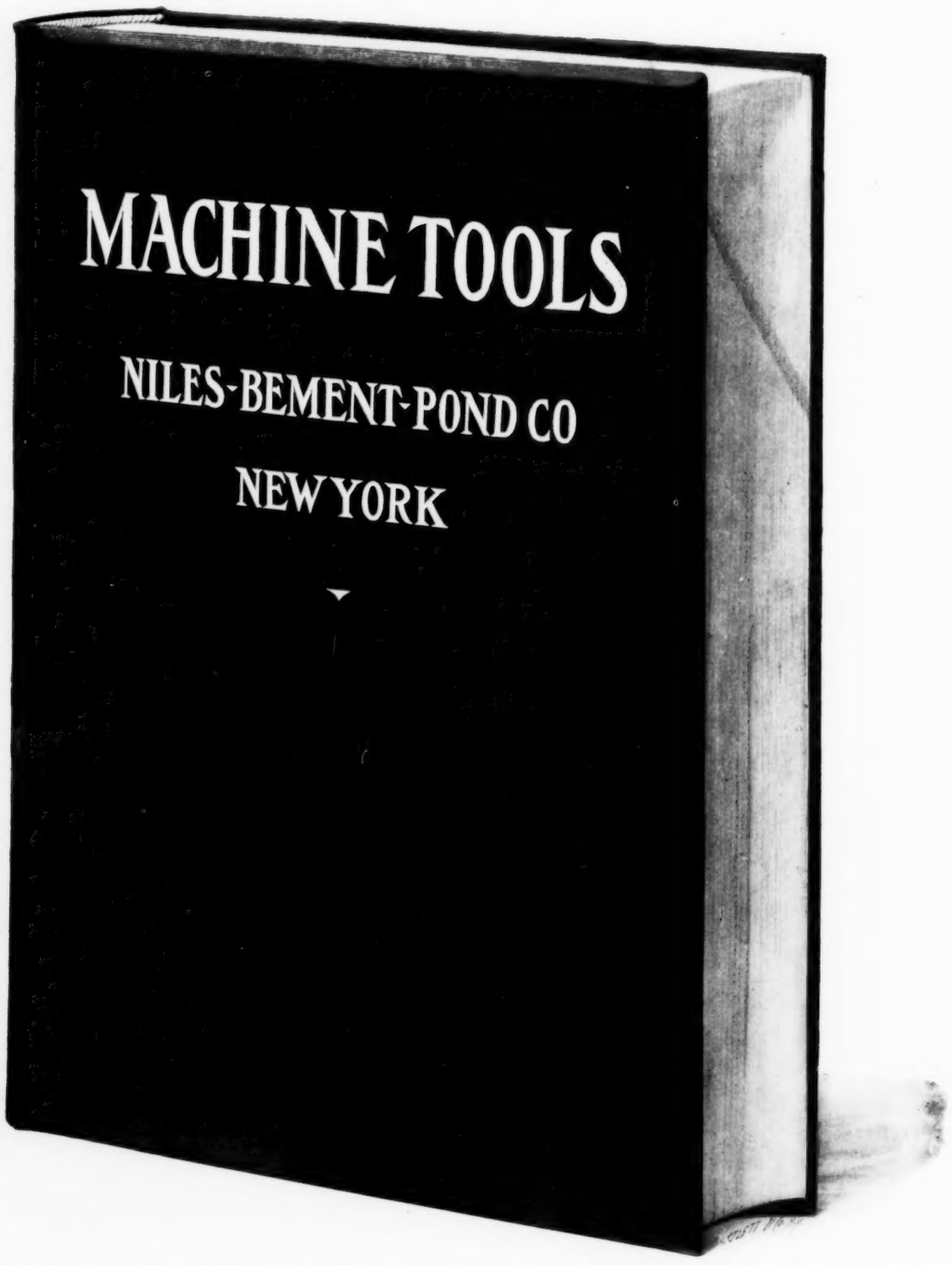

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The Use of Turret Heads on Slotting Machines.

BY R. W. GULICK.

To accurately slot out and finish a rectangular hole in a metal casting is a task of considerable difficulty in that the hole has four surfaces and four angles, each of which must be finished to exact size. To accomplish this with an ordinary slotting machine equipped with a single tool-head requires great care and an amount of time out of proportion to the work accomplished.

Dynamo and motor brush-holders are the devices which hold the rectangular carbon brushes through which the current generated in the armature and rectified by the commutator is transmitted to the outside circuit. An exact fit between brush and holder is essential as otherwise heating and destructive arcing would occur, resulting in damage to the apparatus. As each electrical machine of the direct-current type requires a number of these holders, they must be produced in large quantities by the manufacturer. It is therefore of great importance that each operation necessary for their production be performed in the shortest possible time and with the fewest possible changes in adjustment of the tool.

A skillful method of cutting the rectangular slots in holders of the type described has been developed in the works of the Westinghouse Electric & Manufacturing Company, East Pittsburg, Pa., resulting in work which is accurate, rapid and of good finish. The operation is simple and does not require a high degree of mechanical skill. It consists of the application of a turret head to the ordinary slotting machine.

Such a slotter with a single head is sufficient for ordinary work, such as cutting grooves or keyways in shafts, where extreme accuracy in but one dimension is required, but in the work considered all dimensions must be accurate. Two finishing tools are therefore required, each ground to exact dimensions.

It is customary to perform the greater portion of the work with a roughing tool, small enough to work freely on the four sides of the slot, leaving the final light cut for the finishing tools. With a single tool-head valuable time would be lost in repeated changing and resetting of the tools, but the turret head overcomes this difficulty and permits two, three, or even four tools to be successively brought into operation by the throw of a lever. The turret head can be attached to the vertical slide in place of the single head, leaving the machine otherwise unchanged.

The brush-holder casting should be leveled and squared at the start. The hole is then roughed out until but a light finishing cut is required. One finishing tool and then the other are brought into operation by movement of the turret head and the work is quickly completed. The tools are made with cutting edges on two sides to work on two sides of the brush-holder slot. All are accurately lined up at the start. The tools are made with round shanks, and the clamps are made concave to fit them. This arrangement gives a tight grip, insures a vertical position and makes it difficult to throw the tool out of alinement. For all standard castings, standard holding fixtures are made to facilitate the work of setting up.

SLOTTING MACHINE FITTED WITH TURRET TOOL HOLDER.

The modified slotter lends itself readily to work of special design which must sometimes be put through in a great hurry. The accuracy of the method is made clear by the fact that these holders must all be fitted to gage and any imperfection is easily discovered.

Before adopting the method just described, the Westinghouse Electric & Manufacturing Company used the hydraulic broach method for work of this kind. A rectangular tool, slightly tapered, covered with file-like teeth, was forced through the hole by hydraulic pressure. This operation was rapid but considerable hand fitting was required to properly start the tool and also to fit and finish the work. With the turret head and slotter the time required to cut each hole varies from eight to fifteen minutes, according to the size of the hole and design of the brush-holder. The broach method takes almost two and a half times as long.

A Combination Cutting, Drawing and Two-Hole Perforating Die.

BY JACK MARKX.

I show here a novel but efficient combination die for making in one operation from I. C. tin a perforated cap as shown full size in Fig. 1. In this die a positive knockout, or an extractor, operated by the press, is provided, thus doing away with all objectionable springs and at the same time not distorting the finished cap. There is also a perfect guide for the two small punches, which are made from No. 50 drill rod, keeping them so that they cannot shear or bend in cutting and assuring a clean cut.

Fig. 2 is a front elevation and part section of the die, and Fig. 3 a vertical section through the center of the punch, showing its construction and the position of the "knockout" in connection with the press.

Fig. 4 shows the face of the punch, the connecting screws and the two perforating punches.

The gray-iron die plate 1, Fig. 2, holds in position, by means of the four flat-head screws (only two of these are shown), all the working parts, consisting of the cutting-edge, the drawing plug and two-hole perforating die 4, this sunk in a recess in die holder 1, and kept from turning by the dowel pin. The drawing ring 6 rests on the four tension pins 7, the pins resting on washer 8. The tube 10 can be made from gas pipe, the top end being threaded to fit in the die holder and the lower end to suit the adjusting nut. This tube is large enough to allow the punchings from the two holes to pass down through. Two gage pins 11 are placed one at the left side of the die and one at the back, both close to the cutting edge, so that the stock will break through when cut and not bind on the punch, thus doing away with a stripper, and enabling the operator to watch his work more closely.

Fig. 3 is the punch with the stem 1 fitted to the press and the hole bored to receive the knockout stem 2. The down end has a fine thread; the stem or prolongation 4 is left on to back up the two No. 50 punches and to center the cutting and drawing edge 5. This cutting and drawing edge is made from octagon tool steel and bored to fit the stem 4, the thread cut to fit snugly on 1. These two are screwed as tight as possible together. The drawing edge 5 is bored deep enough to receive the knockout pad 6 and about ⅛ inch over the depth of the drawn cap, giving sufficient wear to the cutting edge. The solid part of the punch 5 acts as a holder for the two perforating punches, as shown in Fig. 3 between lines *J J*, thus strengthening the punch. The knockout stem 2 and pad 6 are made from drill rod. Both these were made in one piece, by cutting the rod the right length and truing both ends, drilling and tapping the connecting screw holes 7 and 8 the same depth and then parting the pieces with a thin tool or saw. This was done so that the two screws would start at the same time, and, when set all the way down, would bring the pad 6 true with the stem 2. The pad 6 is then placed in the drawing-edge 5, and the two connecting screw holes are transferred through the solid part *J J* and stem 4. These holes are drilled a trifle larger than the screws for clearance.

The drawing plug and two-hole perforating die 4, Fig. 2, is now turned two thicknesses of metal less than the drawing punch 5, Fig. 3; the two perforating holes are drilled and relieved in the back, the four holes for the tension pins 7 and the dowel-pin hole are drilled, and this piece is now hardened and tempered. The drawing ring 6 is roughed down, finishing the hole to fit 4, truing the top and bottom surfaces, then making the four tension pins 7. The blank or cutting edge is obtained in the usual manner after the size is ascertained and a cap is drawn up. The two perforating holes 9, 10, Fig. 4, are transferred in the drawing punch 5, Fig. 3, for the two punches. This is accomplished best by having the pad 6 with the two screws 7 and 8 in the drawing punch, placing the drawn cap on the pad 6 and driving the drawing plug and cap down on the pad in the drawing punch 5. The hole for the dowel pin 11 is then drilled and the pin is fitted. The punch is

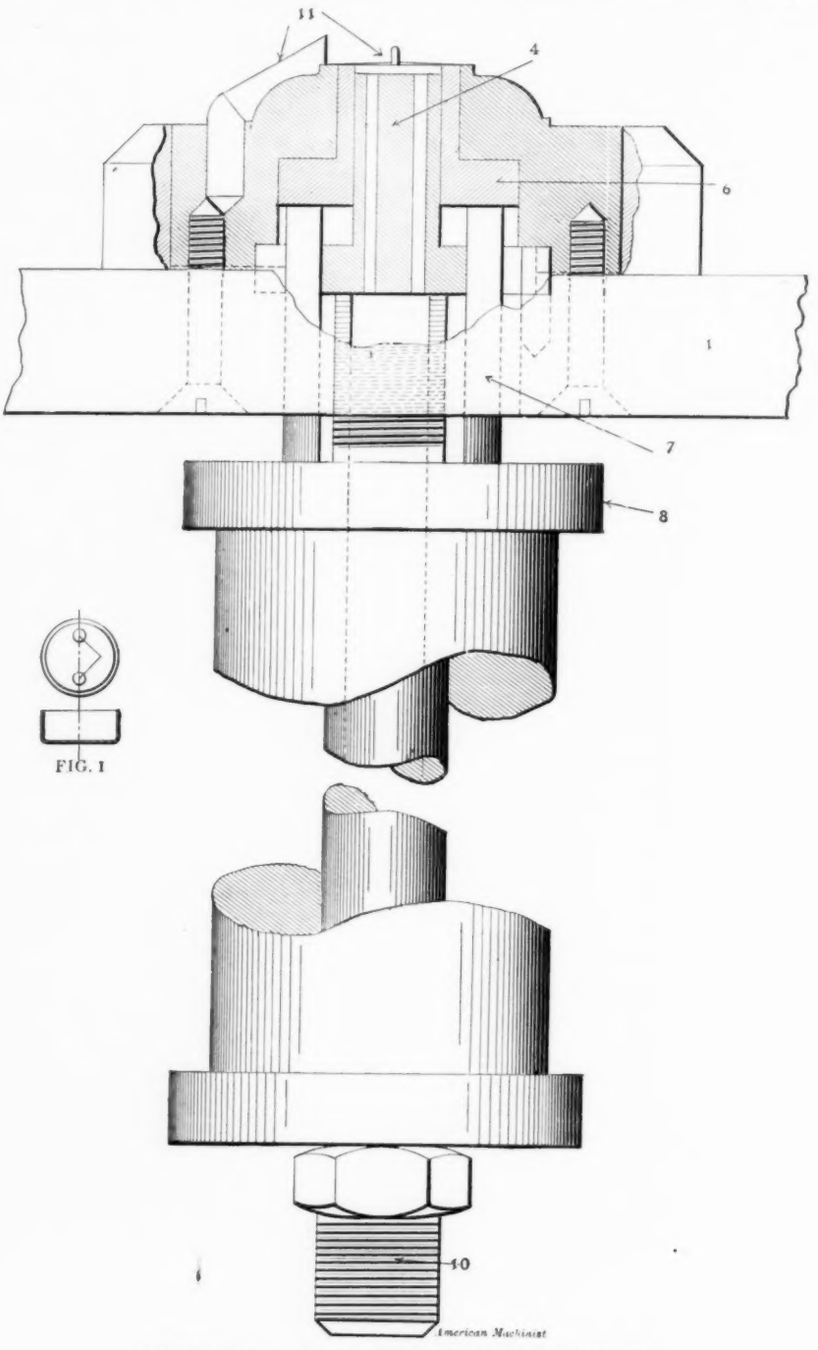


FIG. 1

COMBINATION CUTTING, DRAWING AND PUNCHING DIE.

then taken apart and the perforating punches 9 and 10, Fig. 4, fitted. These punches must not perforate the cap until the metal is all drawn in, so as not to elongate the two holes. The small punches being tempered and in place, the punch proper can then be assembled and the dowel pin 11 driven in place.

The cutting-edge 3, Fig. 2, can now be finished, having found the size of the blank. This should be made from a steel-and-iron forging, that there may not be so much danger of its cracking in hardening, and the four screw holes can be drilled after the cutting edge is hardened and ground to fit in the die holder. Finishing the drawing ring 6, Fig. 2, and turning the cutting edge on the punch 5, Fig. 3, to fit the cutting die, the die proper is then ready to assemble, after fitting gage pins and minor parts. The combination die is then ready to go into the press.

This die I originally designed several years ago, and have made several since for caps of various shapes on the same lines.

Subdivision of Works Management.

The following is the introductory portion of an excellent paper by F. Louis Grammer, presented at the Atlantic City meeting, February, 1904, of the American Institute of Mining Engineers, in which he enumerates in detail the astonishing changes in American blast furnace practice which have taken place in a single decade. The paper is much too long for us to reproduce, and the body of it is not strictly in our line, but this opening portion, bearing upon modern works management in general, will be read with interest:

This article is written to carry out a project of the late Dr. Egleston, to have a record made each decade. I regret that the data collected by him, and forwarded to me, end with 1896, and therefore do not include the interesting results which followed the introduction of Mesabi ores. The perusal of the notes is melancholy reading, somewhat like the feelings we experience in going through a graveyard. It is a record made up of so many plants which have ceased to be factors in the iron world, if they are not entirely moribund. Historically, they would be interesting, emphasizing as they do the abnormal and somewhat overestimated importance of furnace lines, taken without proper reference to volume of blast and nature of stock used.

Nowadays, the administration at some plants is such that the superintendent has become a train-dispatcher or a burden-clerk; and this is particularly the case in those plants in which the engineering duties have been divorced from the executive functions of the superintendent, and where the preparation of ores is made at the mine rather than at the plant. At such plants, usually consisting of four or more units, the proper feeding of the furnaces with a mixture which the past has demonstrated will not make it ill has become one of the superintendent's primary duties. The traffic management also is important, and at several plants running from 3,000 to 14,000 tons of raw material daily, excluding metal made, is equal in tonnage to that of many railroads. In addition to the traffic consideration, the cost and supplying of labor in these troublesome labor times is properly deemed ample responsibility for the superintendent.

This distribution of duties is in line with the general tendency of the age to

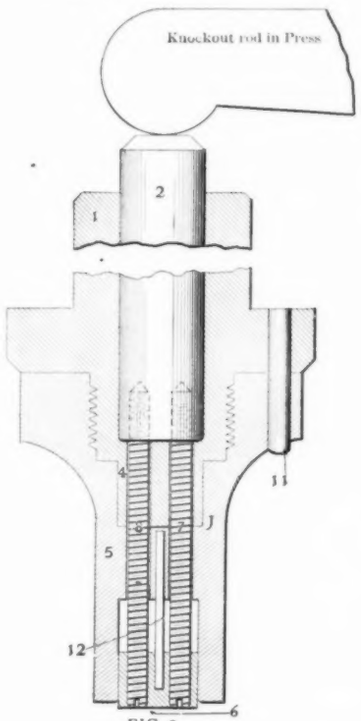


FIG. 3

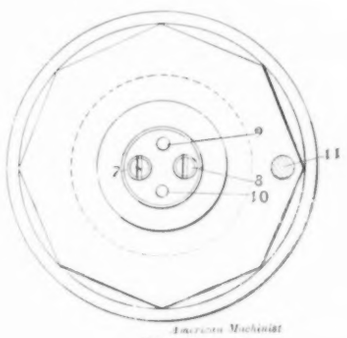


FIG. 4

THE PUNCH.

differentiate the duties of the laborer and the under executive, as well as to integrate between wider limits the responsibilities of the fewer and more powerful higher executives, has resulted in many benefits and some colossal errors. It has required the superintendent to be more a reader of events and men, while the engineer becomes more concerned with new devices to harness nature.

In the most powerful companies this division of duties has usually resulted in good, but in those plants, like Saxe's razors, "made to sell," many mistakes have been made. We can look around and see plants well arranged to make iron, but no iron mines to supply them. Others have fine mills, but no furnaces; others, no market. And so the whole decalogue of managerial sins, resulting from a bureaucracy or directorate of untrained iron men, can be run.

While largely due to perfected means of communication, the present state of affairs is indirectly traceable to the Bessemer process, whose Gargantuan appetite suggested the assembling of a large number of units near together. It affords a picture presenting marked contrasts to the time of Baron Stigel, whose return home, after an absence, was heralded by bonfires from the hilltops and the booming of cannon. It was a paternal management and included such diverse industries as charcoal-burning, road-building, farm-management, pottery-making and forge-running; a Pooh-Bah list of duties, picturesque, if not conducive to the rapid development of an industry! His contract that a rose a year should be deposited on his grave forever, at a church in Manheim, Pa., in lieu of a ground rent, is not one that we imagine the ironmasters of to-day would make.

The present conditions are even very different from the management under the Coleman family, so long a powerful and beneficent influence in the industrial world. Their manager was regarded as a family retainer with interests permanently identified with the family welfare. Under their employ the superintendents were as much engineers as managers.

The Bessemer process, by inaugurating the general policy that each process is the servant of the succeeding process, made the furnace the servant of the converter, and the converter of the rail-mill; and in the other direction the coke-oven and the ore-mine bore the burden of the furnace superintendent's criticisms. A marked instance of this is told by a Mr. C., who ran the furnaces for a large plant in the Middle West. At one time he was being hauled over the coals rather roughly by the owner, because the mill was not getting the silicons it wanted. At last in petulance he said, "Are there no rights of the furnaces that the mill is bound to respect?" The answer received was final: "Not one."

Such a condition of affairs made the furnace superintendent's prestige depart, and his responsibilities are aptly described by one manager as being limited to the coke-barrow and the tapping-hole. On the other hand, the mechanical engineer and accountant came to the front.

On the strategic side we find, whereas formerly the ownership of a good ore-property and a good location near the market was supposed to be all that is necessary for manufacturing independence, now one should own the cars, coke-ovens, coal mines, and frequently the rail-

road and the stone quarries, as well as the plant of your former purchaser.

Therefore, at the plant not independent of fuel supply, or whose fuel is expensive, fuel economy is the first consideration, while at the plant in a disturbed labor market, labor-saving devices are of a paramount importance, and at the plant which controls the market the size of the output is the first virtue. Obviously, with such a variety of aims, the chief requirement of one plant may be of secondary importance at another.

Molding a Crane Base.

BY JOSEPH HORNER.

The casting in Fig. 1 was molded without a complete pattern, three of these castings being made by the methods to be described. The casting formed the base or pivot upon which the superstructure of a 40-ton crane revolved. The arms were bolted down to timbers, and a casting pivoted on the boss or pintle of the casting carried the main girders of the superstructure.

It is necessary to compare the casting with the pattern and mold in order to understand how the work is done. Fig. 1 shows the casting in elevation and in plan. The central boss *A*, being large, 2 feet in diameter by 4 feet 8 inches long, would have been an expensive job to lag up in wood. It was therefore struck up in loam and

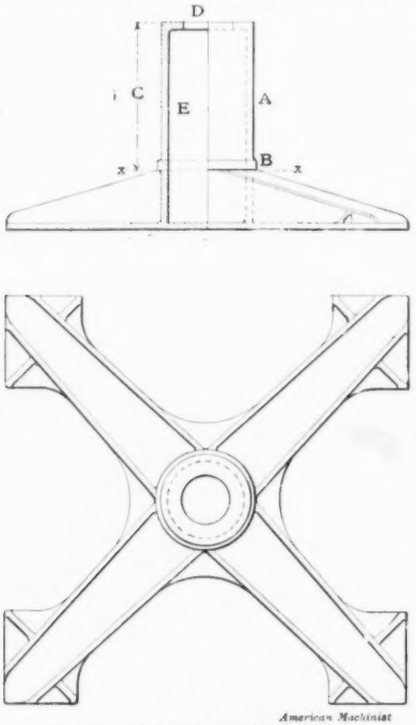
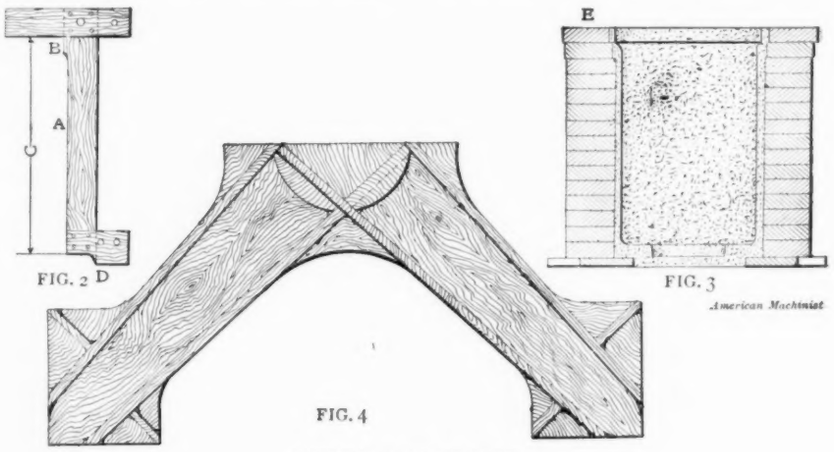


FIG. 1. BASE FOR A LARGE CRANE.

sunk into the floor previous to the ramming up of the cross.

Fig. 2 shows the board used for striking the pintle, and Fig. 3 the loam mold of the same. The part *A* in Fig. 2 strikes the straight part *A*, 2 feet in diameter, in Fig. 1; the part *B* strikes the collar *B*; the length of *C* is equal to the length *C*, 4 feet 8 inches, in Fig. 1, and *D* strikes a print for the end *D* of the central core *E*.

Fig. 3 shows the loam mold of the boss. It is built up of bricks laid radially. One course is sufficient, because although the strain on the mold when pouring is great, the bricks are rammed tightly round with sand. When the mold of the boss in Fig. 3 is struck and dried, it is set in its permanent position, and before it is rammed around the top is leveled. A parallel straight-edge is placed across the face *E* and a level is tried upon it. The straight-edge is laid in different directions in turn, and adjustments of the mold are made, until it is horizontal. If this were not done carefully, the boss would be cast out of truth.



MOLDING A CRANE BASE.

Before commencing to ram the cross, coke beds have to be laid down underneath the horizontal flat-plated portions of the pattern. Coke or cinders are laid down there to a depth of, say, 5 or 6 inches, and covered with an inch or two of hay. It is not necessary to lay these down beyond the area of the plates. Their purpose is to receive the vents that go down from the flat webs. Vent pipes are brought up obliquely from the beds, one from each bed at the outer end. These details are seen in later drawings of the mold.

The half pattern from which the cross is molded is shown in plan in Fig. 4, the timber shading indicating how it is constructed. The vertical ribs are screwed upon the plated portion, the screws passing through the plate so that they can be removed when the pattern is rammed up. The strips that form the plate are halved together next the boss. The pieces which form the broad feet are glued and screwed on separately, and their brackets also. The half boss is formed of two pieces fitted between the vertical ribs. The top face of the boss on the pattern terminates with the line *x x* in Fig. 1, which is coincident with the top face of the loam mold.

The coke bed having been laid down, sand is shoveled loosely all over it, up to about a suitable level for bedding the pattern into. The latter will have to be tried in two or three times until it has a good bedding in the sand, and with enough sand around its edges to hold it securely in place. At this stage, and before the bulk of the ramming is done, it is leveled carefully and set centrally upon the loam mold of the boss. It is leveled by laying a parallel straight-edge *A*, Fig. 5, across it in various directions in turn, and placing a level upon the straight-edge. According to the indications of the level, one portion of the pattern is beaten down and another raised up by tucking sand underneath, until, in whatever direction the straight-edge and level are placed, the level shows the horizontal truth of the pattern.

The half pattern is set centrally by laying a straight-edge *B* along the center of the loam mold *C* of the boss, and bringing the central joint edge of the half pattern up to the edge of the straight-edge. The half pattern is now ready to be completely rammed.

Obviously, in a case like this the sand cannot be rammed underneath the flat plate. The latter is therefore unscrewed from the vertical ribs at an early stage of the ramming, a thing easily done, because all the screws which hold the two together are put in through the plate into the ribs. This plate is unscrewed as soon as sufficient sand has been rammed around the ribs and the boss to prevent the possibility of their being moved out of place by further ramming. The ramming is then completed in detail up to the level of the under face of the plate, the sand being strickled off level with that, the top edges of the ribs furnishing the guides for the operation. Before the strickling off is done, the vents are carried down to the coke bed beneath, a long 5-16-inch or ⅜-inch vent wire being used. These vents are pierced pretty thickly, say 1 inch apart, going from the top of the mold down to the cinders. These are carried all over the area covered by the plate, and some are taken down a little way outside the ribs. Then the sand is finally tried over with the fingers, the damaged faces made good, and the whole strickled over level with the tops of the ribs. Finally the plate *A* is screwed on in place, and the

ramming is carried up to its edges and to its top face. As there is a good depth of sand, in consequence of the depth of the ribs, rods are driven down, going well into the bed below to support the sand.

At this stage it is most convenient to ram the cope. This is perfectly plain, so that it might be rammed on any leveled bed away from the pattern; but it is better to ram it over the half pattern, because the cope can be returned into its position, guided by the stakes, with the top print impression central. To ram the cope in position, it is necessary to fill with sand all the area not occupied by the half pattern, for the temporary purpose of affording a perfectly level bed to ram on. This sand is strickled off level with the half pattern which has just been rammed, the top face of the pattern affording a suitable guide for the leveling. Parting sand may be strewn over the face so obtained; but it is better to lay sheets of brown paper over a large surface of sand which has to be rammed on, because it does not yield so readily as the sand beneath the rammer, and the surface therefore comes out more free from inequalities. The cope is well liftered, and vented over the areas occupied by the cross. After it is taken off, and turned over, the surface of the sand is tried with the fingers, and portions that happen to be too loosely rammed are consolidated, and the surface properly smoothed and finished and blackened.

The other half of the mold is now made. The half pattern is withdrawn from the portion just rammed and turned around into its new position, the temporary sand on which the cope was rammed being mostly dug away and removed to receive the half pattern, which is set by the same methods as before. The joint face across the center is set over the center of the mold of the boss, and the top face of the plate is leveled in all directions. At the part where the ribs come against the ribs already molded, the molded portion is filled in with pieces of wood to prevent the sand from being pushed into the mold. After this is done, the ramming, venting and rodding proceed precisely as the same operations were performed on the first half of the mold. Fig. 6 shows the mold as it appears at this stage, one-half being finished, and the half pattern lying rammed in the other portions.

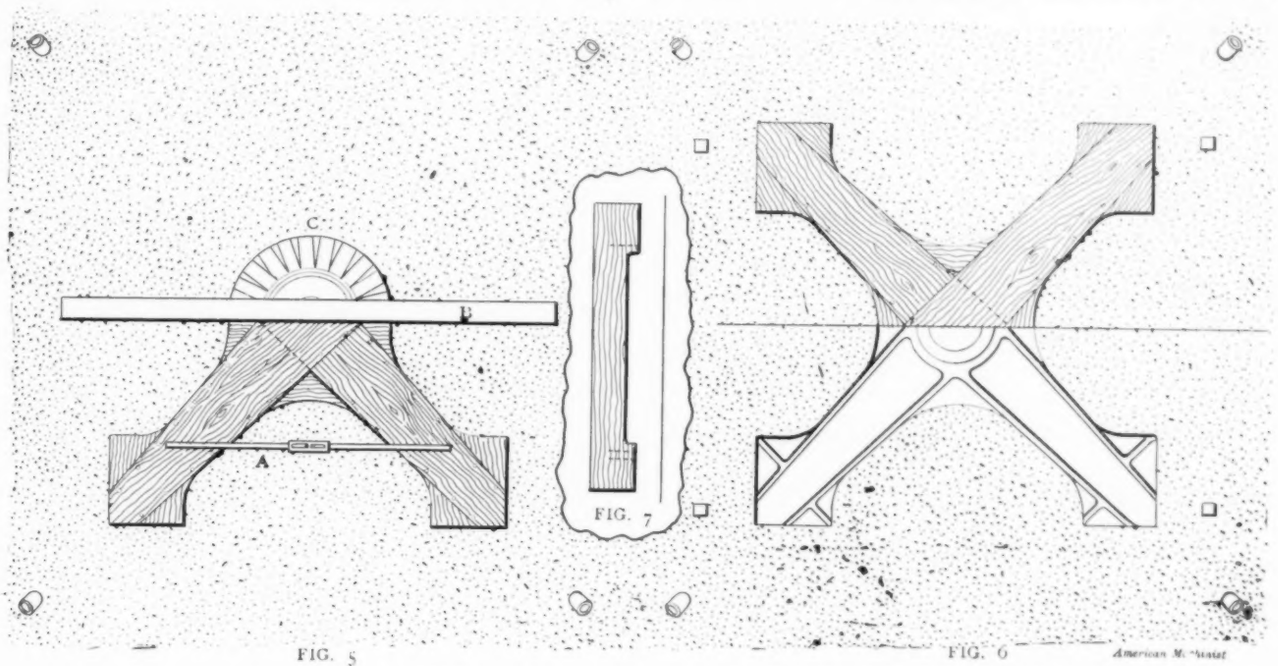


FIG. 5 FIRST SETTING OF THE HALF PATTERN.

FIG. 6 SECOND SETTING OF THE HALF PATTERN.

The central core is struck against the board, Fig. 7, with core bar, hay bands and loam. The core is stood in the bottom print in the pin mold, and enters the top print in the cope, and the core bar projects through the cope to bring off the vent from the core. The mold is poured at the central boss, and one riser or flow-off gate is brought up from the end of each arm. The mold, as thus completed, is shown in Fig. 8.

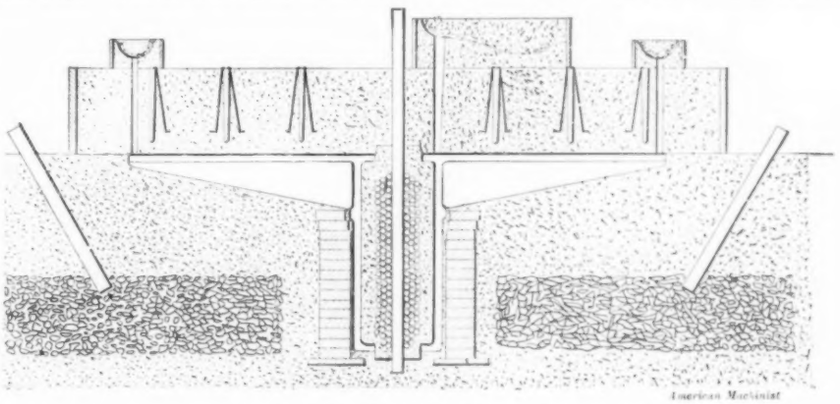


FIG. 8. THE MOLD COMPLETE.

Echoes From the Oil Country—Trying to Use Gray Iron Chips in the Cupola.

The high price of pig iron for a number of years back and the difficulty of getting it when it was needed, besides interfering with the regular course of business has made many a concern wonder if there was not some way by which it could get along with a smaller supply without hurting the business.

One point that we had often discussed (the foundry boss and myself) was whether we could not use the gray-iron borings and turnings in the cupola to advantage. All of the information that we seemed to be able to get on the subject was to the effect that some people claimed that it could be done, while others claimed that it was a failure. We couldn't get any definite information as to how either side operated.

Some time ago the mills that usually took all the chips that we made seemed to get filled up beyond the regular point and for a time refused to buy any. If

prices were quoted at all they were very low, in some cases being in the vicinity of $3.00 per ton. This we took to be a good time to do a little trying with cheap material, and after gathering all the information that we could we started in to use up our chips as part of our regular charge.

We made up rough strong boxes that would hold about a hundred pounds each and filled them full of good, clean chips,, and charged them in as an extra in addition to our regular charge, the idea being that we could gage the saving by the decreased melting loss.

A friend in a neighboring city who also was interested in the subject had taken off a special heat in which he had used some steel chips. The total of chips of both kinds, gray iron and steel, had been more than 50 per cent. of the total of the heat. This heat had not been taken to get iron for castings, but simply to demonstrate whether he could melt the chips without burning them up, and the results obtained seemed to indicate that he could, at least under the conditions which ruled when he had done the work.

After studying his methods and his results we decided that we would try along the line of using them under the regular working conditions, and in such quantities as we thought could be used as part of the regular charge. This led us to use from 1,000 to 1,300 pounds to the charge. The charges ran from 15,000 to 20,000 pounds. After we had continued this for more than a month, we were not prepared to say that we got enough iron from the chips to pay for them and the boxes.

I do not think that anyone who is running a foundry will be surprised to hear that we were not sure whether good or bad scrap could not make as much difference with our melting losses as the use of the chips seemed to. We watched the stack closely for evidence as to whether we were burning the chips up or not, and in connection with the appearances there we put the boxes in in various parts of the charge. Our final conclusion in this direction was that we got the best results by putting them in the last part of the charge, so that the lighter iron and the coke would settle around them well. We reasoned that the boxes would hold together better under these conditions, and that the chips would be more apt to soften and stick together before the greatest heat of the blast struck them. This was the place where we charged them in the trial heats that we took in our endeavors to get closer to the real facts in the case.

The uncertainties as to just what results we were getting led us to take off a series of heats for the purpose of deciding whether to continue to use the chips or not. While we knew our average melting losses we decided to take a series of heats to get as closely as we could the losses under the conditions existing at the time. For this purpose we took off six heats in which we did not use any chips. In these heats all of the iron was very carefully weighed, both to and from the cupola, and the conditions were kept as uniform in every way as we could keep them and get out castings. In all of the following heats we tried to get the same uniform conditions.

As it had been an unsettled question with us as to the value of the "shot" that is gathered up (aside from the very important one with some people of having a convenient scapegoat for hard spots in the castings to vex the soul of the machinist) around the foundry, we took off six heats to see what our losses were with this shot. We then took off six heats using chips in boxes. Not being satisfied with the showing made by the chips, we took off six more heats with chips in.

The results of these heats are given in the table, and at first glance they may not seem so bad for the chips, but as soon as one goes to analyzing the results a little they are discouraging where it is thought desirable to try to use the chips.

Assuming that the loss of 5.4 per cent., as shown in series of heats 1, is a fair average of all the heats for the pig and scrap, it follows that the differences between that and the percentages shown in the other series are due to the extra losses of the materials that are in them that were not in the first or trial series with pig and scrap alone, and, if this be true, then the total loss of the shot would be 28.4 per cent.; of the chips in series 3, 71.47 per cent., and of the chips in series 4, 93.99 per cent.

Pig	66,600	67,895	84,200	80,450
Scrap	47,400	47,150	36,200	30,550
Shot	. . .	3,600	. . .	. . .
Chips	. . .	. . .	7,200	5,400
Total Charge	114,000	118,600	127,600	116,400
Total Recovered	107,844	111,366	116,652	105,331
Total Loss, Per cent	5.4	6.1	8.58	9.51
Shot Loss	. . .	28.4	. . .	. . .
Chip Loss	. . .	. . .	71.47	93.99

TABLE OF MELTING RESULTS—SIX HEATS TO EACH SERIES.

It will be noticed that the amounts of pig and of scrap in the various series are not the same. This is due to the fact that we were running primarily for the purpose of getting out castings, and that fact had the right of way. We had to do the experimenting with the chips as best we could without interfering with that function of the establishment; indeed it was for the purpose of helping that function that we were conducting the trials.

While we realize that these figures are not close enough for any general application, yet it would appear that after making every reasonable allowance it still is a very poor showing for the chips.

I do not wish to give up if there is a way in which these chips can be used by us and not cost any more than they are worth, as we have been selling them to the dealers. If they will take the place of part of the scrap they will tend to uniformity in the charge to that extent, as it is far from certain what the analysis of the scrap may be. I have not heard of the most radical advocate of "science in the foundry" having devised a plan for getting an analysis of the ordinary scrap used that he could present without considerable hedging.

In regard to the effect of the chips on the castings, I can say that we did not find any bad effect of any kind, and would have felt safe in using them in much larger quantities as far as that was concerned.

If there are others who are using chips and getting results, I would be glad to know how they handle them, and if their methods will fit into our conditions we will see if we can do better.

The boxes we used were made of rough pine and hemlock one inch thick, and were securely nailed together so as to be as strong as possible.

A friend has suggested that it may not be entirely clear how I obtained the percentages given. Those at the bottom of the table were obtained by subtracting the iron obtained from the cupola from the iron charged in, and the difference is this loss expressed in per cent. of the original quantity. The loss on the shot was obtained by assuming that the loss on the pig and the scrap was the same as in the first series and that the difference of 0.7 per cent. was due to the loss on the shot being greater than the loss on the others to this amount. This loss of 0.7 per cent. on the entire amount was found to be 23 per cent. of the amount of the shot, and the loss of 5.4 per cent. added to it gives 28.4 per cent. as the total loss on the shot. At this rate we think that it pays to use th shot.

The percentages on the series using the chips were obtained in the same way.

It is plain that if the real loss on the pig and scrap was only a little larger than that taken, it would make a great difference in the showing for the chips, one per cent. of a raise representing a drop of 21 per cent. on the chips, but even taking that into consideration and giving it all of the benefit within reason, the loss on the chips is still too high. Under normal conditions I should say that with us the loss must not greatly exceed 40 per cent. to make their use profitable, and if it should exceed 50 per cent. I think there would be a loss in the final result.

While we do not make a chemical anal-

ysis of our castings as a regular part of our trying to get out good work, we do make test bars from every heat. Three are for the strength and deflection tests, and one is for the shrink test. From these bars we found that the shrinkage was not increased, that the deflection was just as favorable, and that the ultimate strength was increased. The castings seemed slightly closer in the grain, but did not seem any harder to machine.

In discussing this matter with my friend who is working along the same lines, he says that he believes that it pays him to use the chips, even if the losses are so high as to make them cost more than pig iron does, because of the good they do in closing up the castings and preventing spongy places. His experience agrees with ours that the castings are made denser, finer grained and stronger without being harder.

W. OSBORNE.

A Drilling Puzzle.

The illustrations pertain to what is the most curious process of wire making that has ever come to our knowledge. In the shops of the B. F. Barnes Company, of Rockford, Ill., they drill a good many holes in the ends of spindles. In this case such a hole had been drilled by the use

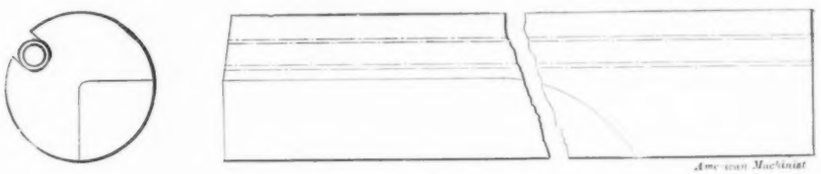


FIG. 1. THE DRILL THAT MADE THE WIRE.

of the single-fluted oil drill shown in Fig. 1, which drill is used in the works for drilling holes from 3 to 15 inches deep. In this case the hole was 1 inch diameter, 3⅞ inches deep, and after it was drilled there remained attached to the bottom of the hole a piece of the material of the spindle which had not been detached and which was in the form of a wire .018 inch diameter and 11⅜ inches long. The engraving, Fig. 2, shows the spindle supported by this wire, the upper end of which is gripped in a pair of pliers. The spindle weighs 26 pounds, and we are informed that the wire is capable of sustaining a greater weight than this. The interesting point is as to how this wire was formed and how it comes to be about three times as long as the hole is deep.

It takes more than three times as much water to saturate air at 100 degrees Fahr. as is required at the freezing point. One cubic mile of air at 35 degrees Cent. (95 degrees Fahr.), if saturated with aqueous vapor, will, if cooled to the freezing point deposit 140,000 tons of moisture as rain Rain is not necessarily carried in "clouds," but generally in clear air until the time approaches to discharge it.

The Use of High-Speed Steels.

BY E. R. MARKHAM.

I remember hearing it said, a number of years ago, that Mushet's self-hardening steel, as it was then called, would eventually supersede tempering steels for all shop tools for which the steel could be worked into the shape of a finished tool when hot. It was not then generally, if at all, known that it was possible to anneal this steel. In some shops all tools for ordinary lathe and planer work were gathered up and thrown into the scrap heap, because it was claimed they could not afford to use the old steel when it was possible to get the new, even at its increased cost. In a few months, however, the scrap heaps were pretty thoroughly overhauled, and the concerns that had not disposed of their junk in the meantime considered themselves extremely fortunate. This reaction did not detract from the actual value of the Mushet steel for certain purposes, but it did tend to discourage the manufacturer for a time from buying anything but the "true and tried." As a fact, the steel was a valuable adjunct, and had its use been confined to the work for which it was adapted and had not impossibilities been expected of it, its use would have been much more general than was the case.

When high-speed steels, so called to distinguish them from the original air-hardening steels, first came to our notice, it was a difficult matter to interest manufacturers who had a few years previously made the change, and then returned to the tempering steels—and in fact some of them would not take the steel as a gift. I personally know of manufacturers who a year ago were very much interested in the new steel who have discarded its use and will not have it in their shops, and all because the steel furnished was not uniform in quality, or the smith did not work it according to instructions, or perhaps the machinery was not strong enough to carry the cuts, speeds and feeds that the steel was capable of taking.

Many times the machinery used in a shop for certain purposes is not sufficiently strong to do the maximum amount of work possible for tools made of *tempering* steels, provided they are properly made and hardened; and in such cases it is folly to throw away the tools on hand and replace them with others made from a steel costing four or five times as much and from which it would not be possible to get any better results. Possibly the desired results might be obtained, but only by tightening belts to a degree that would strain the bearings so that when the additional speed and feed were applied the machine would tear itself to pieces in a few weeks.

A few months ago I was visiting a shop where a great many planers were used in

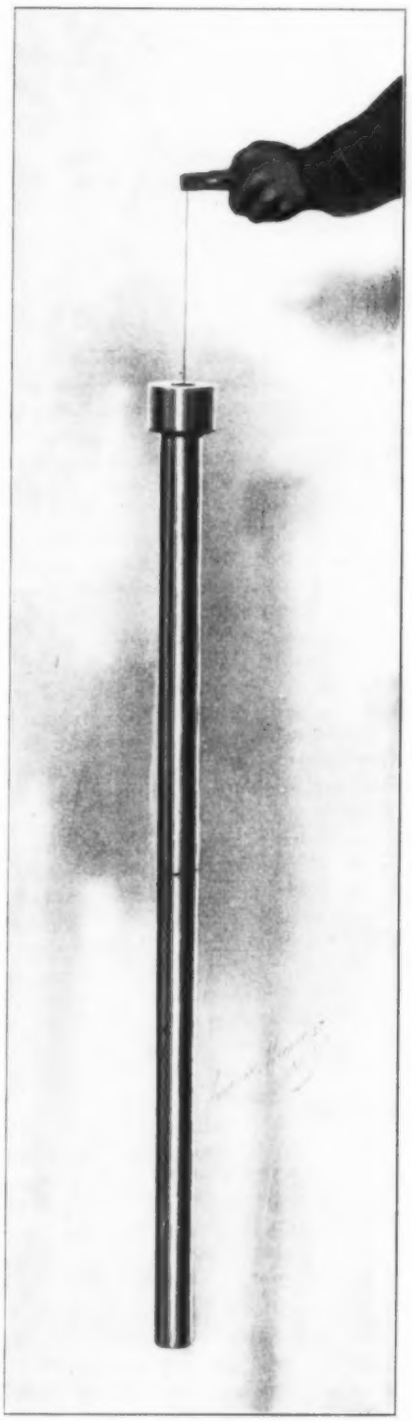


FIG. 2. WIRE FORMED IN DRILLING.

machining the product. I made inquiries as to whether they used high-speed steel, and was informed that they did not now. At one time they bought a lot of it, made it up into tools, and, in order to get the desired results, speeded the planers up very

fast. I asked how the steel stood up, and was told that the steel stood it better than the machinery, that they had ruined several planers and injured others and brought on heavy repair bills because of which the planers had been slowed down to their original speed and the high-speed tools gather up and thrown away and the old steels reinstated. I failed to see the wisdom of the policy and question the advisability of the action. Wouldn't it have been better to reduce the speed to a point where the machines would have stood up and yet be run faster than would have been possible when using tempering steel? Not only would the product have been increased in this manner, but it would have been possible to take heavier cuts and coarser feeds, and the tools would have stood up longer between grindings, which in itself is quite a factor.

Personally, I am an advocate of high-speed steels, but think reason should enter into every matter of this kind. If our lathe is light and weak and we cannot see our way clear to get just such a lathe as would be necessary in order to get the best results from the steel under consideration, it would not be wise to substitute tools made from this steel and then, in attempting to get maximum results, tear our machine to pieces in a few days or weeks. I am aware that men selling this steel say that in such cases it is advisable to put in machinery that will stand up when the tool is doing its maximum amount of work, but not every manufacturing concern is in a condition to replace its present equipment with machinery adapted to the new steel.

This steel is a comparatively new product, and the process of manufacture has not, in many cases, been perfected, to make it possible to send out a *uniform* product. Parties buying the steel should bear this in mind, and not condemn *all* high-speed steel because they get a bar that will not do what is claimed for it. A very common trouble experienced when using this steel is the tendency to break in the tool-post, especially when cuts are taken that subject the tool to varying strains, due to projections and other causes. At times the cause for this breaking is the construction of the tool-post, which subjects the shank of the tool to a breaking strain. One user will complain because his tools give this trouble, and another will say he never experienced this trouble and there is no need of it, but were he to work under the same conditions he would experience the same troubles, unless he took precautionary measures. I have seen several of the leading makes of this steel act in this manner, including the one that is supposed to be the best on the market. The trouble was overcome by annealing the steel before making the tool. After annealing the tool was forged to shape and hardened, and no further trouble was experienced.

The steel may be very nicely annealed and put in condition to machine into tools of any shape by packing in an iron box with dry fire-clay and subjecting it to a heat somewhat hotter than for annealing tempering steel. It is necessary to continue the heat for a much longer time than with ordinary steel, the length depending on the composition and size of the steel, and varying from fifteen to thirty hours. The steel should cool very slowly.

In a number of shops the use of the steel has been discontinued because it did not give good results, although the trouble came from the treatment it received in the forge shop. It was either forged at too high or too low a heat and thus rendered unfit for use. We all know it is necessary to heat this steel to a very high heat for hardening. I have tested milling machine cutters hardened at a bright yellow, which were not hard enough to use, even if the cutters were run at the speed customary for tempering steel, and yet these same cutters when heated to a dazzling white and dipped in oil could be run at speeds and feeds that would tear the machine to pieces in a day.

A very common trouble is an air blast which is too small and of insufficient force to produce the desired result. Experience has convinced me that tools held from 4 to 6 inches from the mouth of blast harden in a more satisfactory manner than if held in the mouth of the blast. Large, heavy sections do not seem to harden very deep, and it is often necessary to reharden after a number of grindings. When grinding on a *water* grinder, be very careful not to heat the tool or the water, striking the heated steel will cause it to crack in innumerable fine lines. Give this steel the same consideration that would be given to any new thing that is but imperfectly understood by even the best posted. Do not expect to realize more than 50 per cent. of the claims made by the representative of the steel. Even at that the result is a first-class investment; and if luckily 75 per cent. or all of the claims made are realized, it will be an agreeable surprise.

Do not imagine that it will supersede tempering steels, although it has had a very desirable effect in leading steel makers to improve their product very materially. I tested a special brand of tempering steel only a few days ago, that showed harder and much stronger after hardening than any tempering steel I had before tested. The fact that such high prices could be obtained for the high-speed steels has led unscrupulous dealers to put out worthless articles that so disgust the buyers that some of them will not talk with anyone representing any of these steels.

I think, however, if we buy of reputable dealers and treat the steel according to directions, we will get results that will justify us in buying and using it for work it is adapted for.

A Lifting Table—Finishing Mower Wheels.

BY S. A. WORCESTER.

The foreman in charge of assembling harvester wheels wanted a table with a device of some kind for lifting the wheel, weighing about 130 pounds, from the floor. Two men were necessary for lifting the wheel from the floor to the stationary table then in use, and they could not work to as good advantage as one man in assembling the wheel. My fad, the spring counterbalance, occurred to me as the proper thing, and the result of its application is outlined in Fig. 1. The two legs *L* of the table, strongly framed, are drawn toward the vertical position by three springs *S*, pulling on the lower end of the legs and fastened to the base at *B*. The effect of the springs is adjusted by moving *Y* to or from the fulcrum *F*. They are adjusted to slightly overbalance the table and the wheel *W*. The table is fastened in either upper or lower position by the treadle latch *T L*, which engages either of the two notches in the sector *T S*.

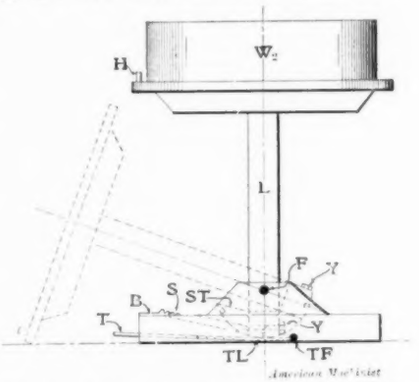


FIG. 1. SPRING COUNTERBALANCE LIFTING TABLE.

When changing wheels, the table is left in the lower or dotted-line position. The wheel *W2* is rolled up close to the table and on two lugs *H*. The treadle *T*, which is held up by a spring and is fulcrumed at *T F*, is then pressed, throwing the latch *T L* out, and the springs *S* throw the table and wheel, steadied by the hand, up to the full-line position, where the latch *T L* again engages *T S* and holds the table in place. When the wheel is assembled the treadle latch is released and a pressure of perhaps 10 pounds with the hand swings wheel and table down where the table is caught by the latch and held while the wheel is rolled off and another put on. This device made the work easier for one man than it had been for two, and by saving about 35 cents per day in labor cost soon paid for itself. It was set opposite a third-story window, which was left partly open in summer and a small boy learned a lesson in applied mechanics from it that he will probably remember. It was left latched down at the noon hour, and the boy, putting one foot on the lug *H* and the other on the treadle, just below it, was thrown neatly into the window, and would have fallen to the ground if the

window had been open wide enough to let him pass.

For boring and facing mower wheels three machines, somewhat similar to Fig. 2, were keeping two men busy, including the drilling of oil-holes in the hubs, which was done at a small upright drill nearby. The feed used the gears *G* and worm *W*, outlined in the sketch, but the disengaging arrangement was a pair of friction cones tightened by a hand nut at the outer end of the hand-wheel shaft. The female cone was in the worm gear. The length to which the wheel hub was to be faced was marked with a scriber on the hub, and when the boring tool *M* with four flutes had finished boring, the facing cutter *F M* was watched closely and the feed thrown out just as it faced to the mark.

It occurred to me that these machines could be made automatic at small expense, and I designed the alterations and attachments outlined in the sketch. The female friction cone in the worm gear was bored out straight and a tool-steel clutch ring with jaws about ¼ inch wide was set in and screwed fast with four screws. The clutch jaws were of the form now commonly used for disengaging the feed for quick return on drills. The mating clutch, however, instead of duplicating the other, had but four teeth, two in each of the hardened steel shouldered sliding pieces *J*, which slide in and out ¼ inch through the disk *D* and are pressed inward against their shoulders by light flat springs *F S*. The horizontally sliding bar or clutch shifter *S B* engages a groove around the hub of the disk and when the hand-wheel with its disk *D* and jaw pieces *J* is pushed inwardly the bar *S B*, sliding horizontally with the hand-wheel, is caught by a spring latch at *S L* and holds the clutch in gear. If the clutch jaws are not opposite one another the flat springs *F S* are forced out until the jaws come opposite, when the springs instantly push *J J* into gear. Pulling the lever *F L* toward the operator throws out the latch at *S L* and pulls the bar *S B* to the front, throwing the clutch out. The adjustable stop-collar *S C* has two beveled faces, one of which strikes latch *S L* and throws it out and is followed by the other striking the beveled side of a groove in the side of the sliding bar *S B*, forcing it forward and throwing out the clutch. This device, properly set, faced the hubs to uniform length without attention after starting.

As the large step of the driving cone was not used for anything else, it was made to drive the oil-hole drill which was attached, as shown, to the column, holes being cut through for it. When not at work this drill was held in the horizontal position shown by the upper dotted lines by the spring *S* which held its cast-iron bearing *C I B* up and back against a shoulder. The feed bar *F B* was engaged at its upper end by a projection at the rear of the spindle sleeve, and when the main spindle was fed down *F B* was also forced down, its upper end swinging on the slotted links *L*, radially from the fulcrum *F*, while its lower forked and beveled end forced *C I B* down to the slanting position till it rested on the knee *K* and then wedged it away from the column, feeding the drill to its work. This drill was a ¼-inch flat drill with a ½-inch round shank held in the spindle by a set-screw. A tool-steel tumbling rod *T R*, 13-16 inch diameter and with a very simple sliding universal joint at each end, transmitted power from the outer pulley spindle to the tipping and advancing drill spindle which had an endwise travel of about ⅞ inch. When the oil-hole drill had made its travel the radial movement of the upper end of *F B* disengaged it from the spindle sleeve and the spring *S2* threw it back to the dotted line position while the drill was returned to its idle horizontal position by the spring *S*.

The mower wheel, weighing 85 pounds, was lifted to the machine table by a spring balanced lift of my design, similar in principle to Fig. 1, but much smaller and made of cast iron and steel, and placed directly in front of the machine. Its half-round, half-flanged top, made to suit the flanged hub of the mower wheel, came to the exact hight of the face-plate so that the wheel moved from floor to machine, and *vice versa*, without any stop or hitch. The cycle of operations for finishing the mower wheel is about as follows: The wheel is rolled up and leaned over with its flanged hub resting in the flanged top of the lift. The treadle latch is pressed and the spring throws the wheel, steadied by the hand, on to the table and a slight push slides it to place in the round, half-flanged hub seat *H S*. The rim is prevented from tipping by three rests *R*. The projection *P J* engages one of the numerous teeth, not shown, on the face of the mower wheel *W* and prevents it from turning. The hand-wheel is now turned until the boring tool *M* touches the hub of the wheel, and is then pushed in, throwing the feed in gear. The oil-hole drill begins its work at about the same time that *M* does, but is through and back out of the way when *M* has bored about 1¼ inches. *M* continues boring until through, when the facing cutter *F M* does its work, facing the hub to correct length when the stop *S C* throws the

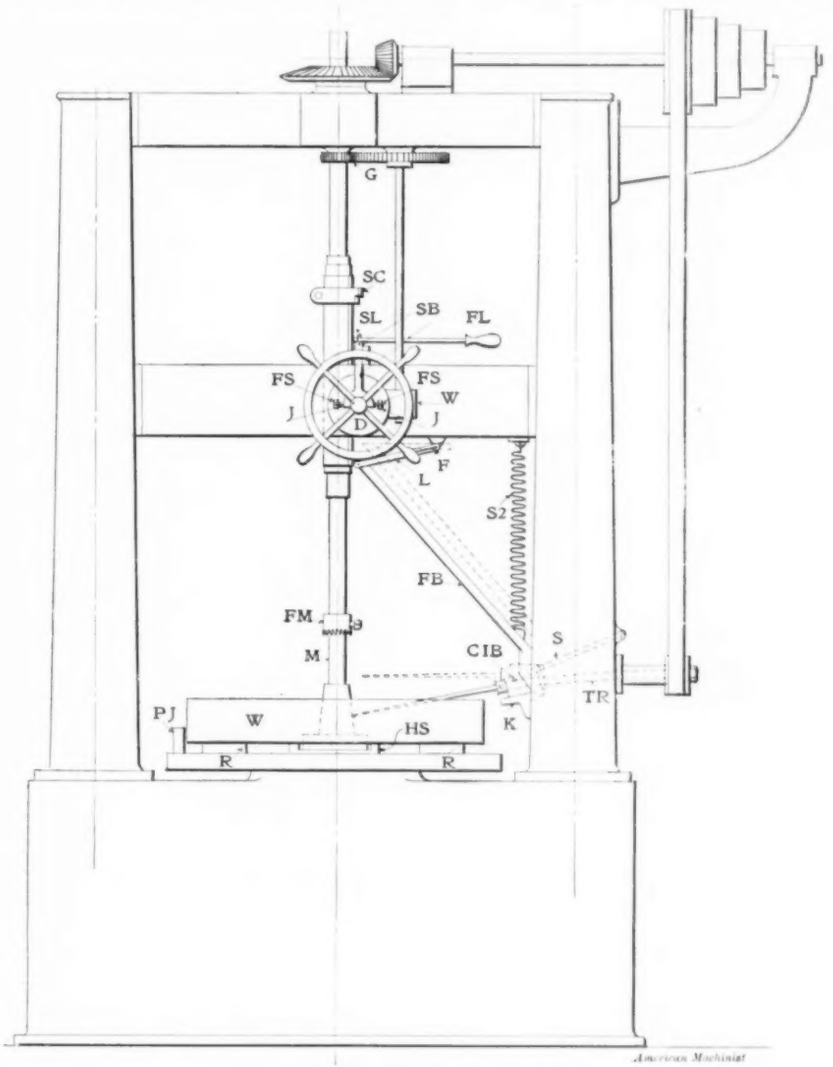


FIG. 2. BORING AND FACING MACHINE.

feed clutch out of gear and the main spindle, being heavily overbalanced by a weight hanging in the left-hand column of the machine, runs rapidly up out of the way and is arrested by a spiral spring buffer. The wheel has now been bored, faced to correct hub length and drilled, with no attention except a half turn and push of the hand-wheel. The three machines were fitted up in this manner and one man now runs all three with ease and each machine does more work than before, in addition to drilling the oil holes.

An Indexing Milling Fixture.

BY JOS. M. STABEL.

Herewith is shown a fixture that was designed to end mill ten small slots into a special piece of work, it being used on a sensitive drill press and its indexing mechanism being semi-automatic.

FIG. 1
THE WORK TO BE MILLED

As it does this work so successfully, I thought its design might be of interest to others. The piece to be milled is shown in Fig. 1; the dimensions of slot are as follows: 3-32 deep, 3-32 wide at bottom of slot and .150 wide on top, length of cut 5-32. The fixture is doweled on an adapter which has a T-slot that receives the two clamping bolts, one located at each end of the fixture; this adapter is in turn doweled and secured to the drill-press platen. By simply pulling the handle of the fixture down, the work is fed against the cutter until a stop on the handle allows it to go no farther; by raising the handle up, the work recedes from the cutter, and when the same is four-fifths up the index pin is automatically released from the index plate and a pawl engages with a 10-tooth ratchet wheel, thereby rotating the work one-tenth of a turn. These last two movements are accomplished from the time the handle is four-fifths up until it stands perpendicular. In other words, the movement of the handle is about 90 degrees, when it stands parallel with the platen of the machine the cutter is full depth into the work; raising the handle 72 degrees makes the work recede from the cutter another 5 degrees, and the index pin is disengaged, while the remaining 13 degrees indexes the work for the next cut.

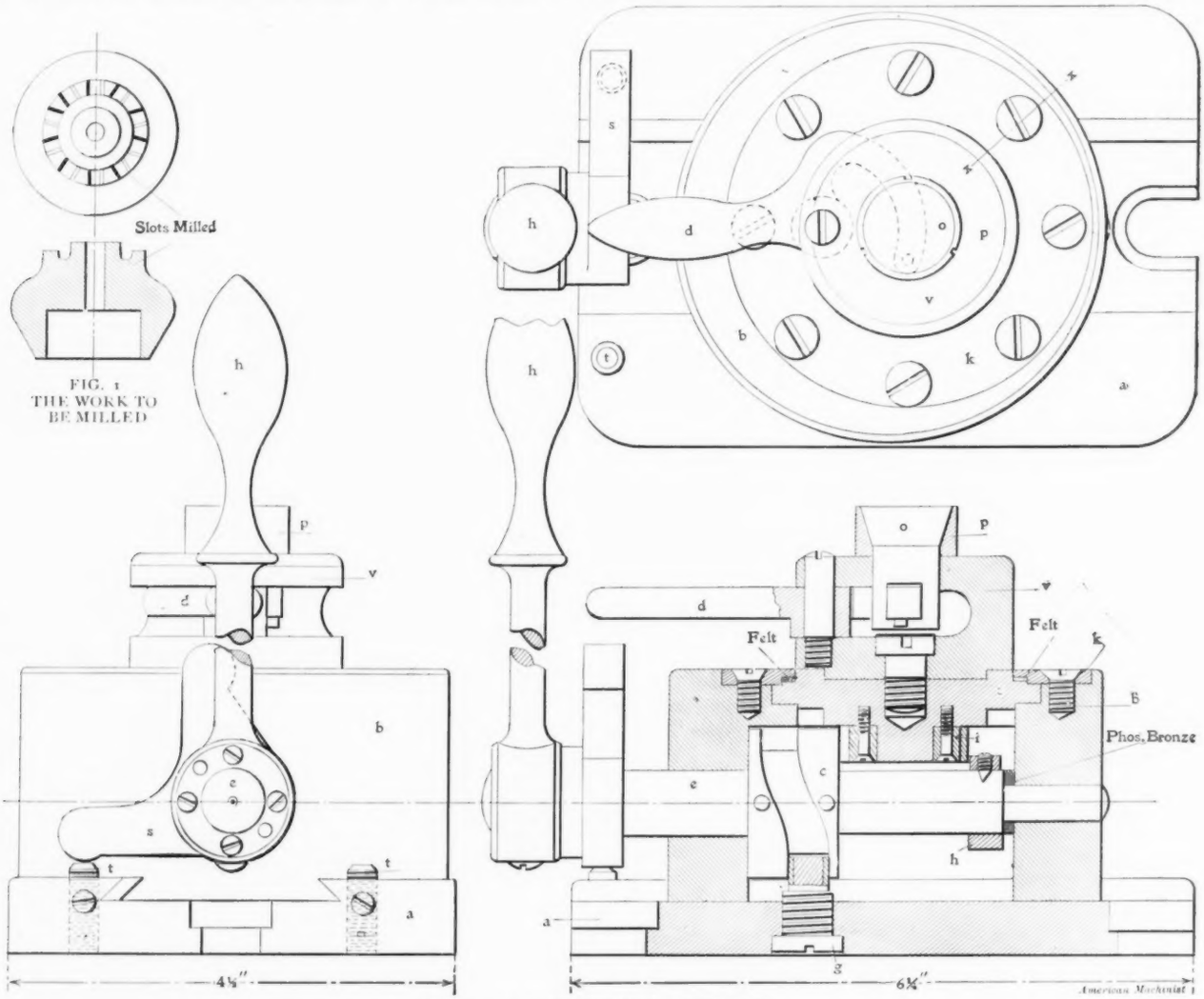


FIG. 2. AN INDEXING MILLING FIXTURE.

A detailed description of the fixture is as follows: The base plate *a* is made of gray iron, it having two 45-degree dovetails planed into it; also has two slots for clamping bolts, two ⅜-inch tapped holes to receive the two adjustable stop-screws *t t*, while two ¼-inch screws located at right angles with the stop-screws serve to hold them in position. A ½-inch tapped hole through this base plate receives the screw marked *g* in Fig. 2; this screw in turn has a roller bushing upon its end which rides in a cam groove; this gives the fixture its longitudina. movement. The main body *b* is made of machine steel; its outer diameter is eccentric with its bore; the reason for this is to have a more equal bearing surface on the base plate *a*. The portion of *b* where the cam *c* rests is milled out as can be seen best in Fig. 3. The bottom of *b* is planed to fit the dovetail in the base *a* minus the thickness of the gib which is held and adjusted by four gib screws. The hole, centrally located for the cam shaft *c*, is ⅜ and ⅝, respectively. The cam shaft *e* carries the cam *c*, which is held securely by two pivot point screws, and the handle *h* on to which is attached the triangular stop, it being held fast by two dowels and four 3-16 inch screws. The dog *f* is also attached to the shaft and this in turn operates the index pin. A phosphor bronze collar on the small end of the shaft prevents the shaft from cut-

ting into the body *b*. The index plate *J* —or turntable, as it may be called—is made of tool steel and is a nice running fit in the body *b;* it is held securely by the ring *K* and eight ¼-inch screws. To prevent dirt and grit from getting into this bearing a felt packing is inserted between the ring *K* and the plate *S*. On the lower part of the plate *S* is turned a boss which receives the 10-tooth ratchet marked *i*. This is held securely by four screws and two dowels; it is made of tool steel and hardened. A pawl inserted in the side of the cam *c* engages this ratchet

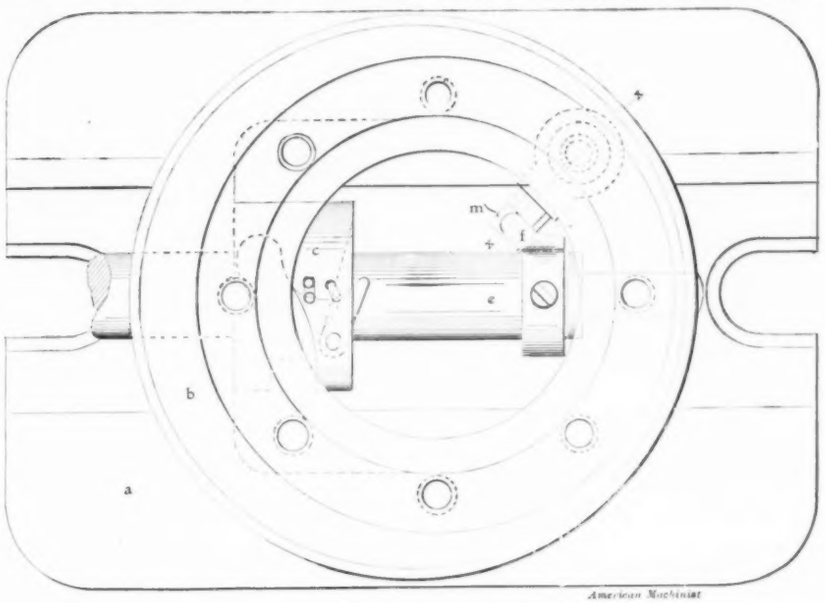
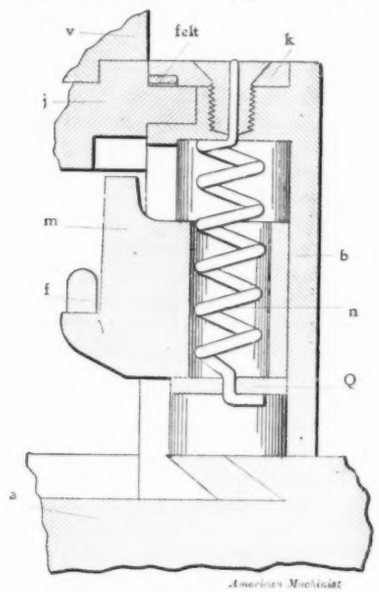


FIG. 3. PARTIAL PLAN VIEW.



SECTION AT X X, FIG. 2.

as can readily be seen in Fig. 3. This of course gives the circular movement to the plate *J*. In this cut the reader can see how the dog *f* acts on the index pin *m*.

Fig. 4 gives the cross-section view through *x x* showing the construction of the index pin *m*. As can be seen, this spring *n* passes through the index pin and is held fast on the lower end by passing through a small disk and a drop of solder placed thereon. The upper end of the spring passes through one of the ¼-inch screws which help hold down the index plate and is made fast thereon; this serves to hold the index pin in the plate when the dog *f* has released itself from it. The index pin, as well as the dog, is made of tool steel and hardened.

The chuck for holding the work is very simple and easily manipulated; it consists of the circular piece of machine steel marked *V*, which is slotted out to receive the operating lever *d*, which is held in position by the screw *U*. A boss on the under side of *V* fits into the index plate *S* and is held securely by two dowels and the screw *W*. The center piece *O* is a sliding fit in *V*, it having an elongated hole through to receive the cam lever *d*. Part of the lever which slides through the elongated hole is tapered on its under side so that it acts the same as a wedge and pulls down the center piece *O*, which in turn has a taper of 13 degrees on its upper end that fits into a spring tempered steel bushing; consequently this expands into the work and holds it.

The production of crude petroleum on the Apscheron peninsula last year amounted to 114,000,000 cubic meters. Taking into consideration that together with the oil the spouters threw out a quantity of water and mud, the approximate quantity of liquid extracted from the ground is 150,000,000 cubic meters, which is not replaced by anything. As the petroliferous area of the Apscheron peninsula does not exceed 10.45 square kilometers, *i.e.*, 10,450,000 square meters, and the above-mentioned volume of extracted matter distributed over this area presents a hollow space of 14.35 meters (48 feet) deep, the question which now arises is why does not this result in any subsidence of the ground?

Expanding Castings by Heating*.

It was my good fortune a few years ago to bring to light some interesting and, I believe, quite valuable properties of cast iron not then known; the new observations now to be described have grown out of those studies and have a close relation thereto, though differing radically in many respects.

Another new observation quite as unexpected and surprising, perhaps, to metallurgists and engineers, growing out of these original studies and tending to corroborate the theory then advanced regarding the mobility of molecules of cast iron, is to be announced to you this evening.

Before proceeding to do this, however, I will ask your kind permission to indulge in a few reminiscences of a somewhat personal nature, as I think they have a close relation to what I am about to describe regarding my most recent experiments, and it is one of the compensations of advancing years to find that one's recollections of experiences of former days begin to acquire a certain interest, if not value, to a younger generation. My introduction to the study of cast iron dates back to the Centennial year, and in 1876 the total production of pig iron (as given in Mr. Swank's statistical tables) was 1,868,961 tons. In 1903 the production exceeded 18,000,000 tons, or ten times that of 1876.

Coincidently with this enormous increase in production during these years came a large increase in the proportion of so-called "metalloids" in pig iron, viz., silicon, sulphur, phosphorus and manganese, and corresponding change in the character of the metal.

I remember, for instance, the time when it was considered that anything over 1 per cent. of silicon in pig iron of No. 2 grade was rather high. Now, 1 per cent. of silicon in this grade of iron is considered rather low. It is probable that if we could ascertain the average proportion of silicon in all of the iron produced in the United States in 1903 we would find that it approximated 2 per cent. If this be correct, it follows that there was produced in that year the enormous amount of 360,000 tons of silicon in the pig iron made, statistical returns of which will not be found in any of the published tables of production of metals and minerals in the United States, for it was all concealed in the iron, and was either burnt up in the converters or in open-hearth steel furnaces, or else entered into the composition of miscellaneous castings made from this pig iron.

At the time of my initiation into the metallurgical work of an iron foundry, the quality and value of pig iron was determined by its fracture. In order to study the methods of grading iron at the fountain head, I visited, in 1881, a number of blast furnaces in Pennsylvania and other States, spending a few days or a week, as

*Abstract of a paper in the *Journal of the Franklin Institute* by Alexander E. Outerbridge, Jr.

the case might require, at each. At one of the first of the large plants I inspected (long since defunct, but at that time a leading producer, with several stacks in operation), I obtained my first insight into these mysteries. Although it was summer weather, the casting-house was kept tightly closed and was consequently insufferably hot. Boards were placed over the hot sand to enable the negro laborers to walk over it, and as soon as the pigs of one cast were removed, new pig beds were made up, even before the sand became cool enough for me to touch. On inquiring of the "boss" of the casting-house why they did not open the doors to allow the steam to escape and the sand to cool quickly, he replied: "Why, you don't know nothing about making iron—it would cost us 50 cents a ton to do that, for all our iron would grade No. 2 instead of No. 1."

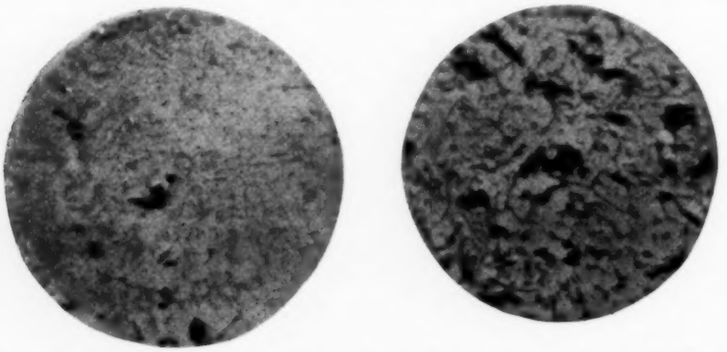


FIG. 1. SHOWING CHANGE OF STRUCTURE AFTER REPEATED HEATINGS OF GRAY IRON.

Here was a revelation, indeed, and from that day to this I have refused to regard the fracture of pig iron as a safe guide to its composition and value.

The supplanting of empirical by scientific metallurgical methods in foundries has progressed rapidly during the past ten years or so, and the recent substitution of "machine cast pigs" (cast in iron molds) in place of pigs cast in sand, has given the death-knell to the crude and obsolete methods in vogue in my youth of grading pig iron by fracture.

It is a common practice to-day in modern "up-to-date" foundries to draw, from one cupola in one heat, soft metal suitable for the smallest pulleys or other light castings, having tensile strength of 19,000 to 22,000 pounds per square inch, in test bars of 1 inch square section, 15 inches long, and iron of very different character, suitable for large castings, weighing perhaps 30 tons or over, having tensile strength of more than 30,000 pounds per square inch.

Recently an unusual metallurgical problem was presented to me demanding special treatment. Some small hollow castings were required for experimental purposes, about 18 inches long and ½ inch thick, to withstand bursting strains under high steam pressure. The peculiar requirements were that the metal must be fine grained, perfectly gray, absolutely soft, free from hard spots or "chill" and, to a certain extent, malleable. Four test bars 15 inches long and of the same thickness as the castings, molded on either side of each casting and attached thereto, were required to show tensile strength, when turned to a diameter of about .35 inch between threaded ends for the grips of the testing machine, of not less than 30,000 pounds per square inch. This proposal was, I believe, submitted to and declined by several manufacturers who considered the conditions impracticable. The castings were made in the foundry of William Sellers & Co., Inc., and the following is a copy of a record furnished to me by the operator of the 100,000-pound hydraulic testing machine of six test bars attached to six castings, all made on different days:

No.	Diameter.	Pounds per Square Inch.
1.....	.310 inch.	41,842
2.....	.310 "	40,533
3.....	.375 "	42,363
4.....	.342 "	43,260
5.....	.312 "	44,210
6.....	.342 "	44,565
Average.....	.332 "	42,795

In gray cast iron the molecules or crystals of iron are comparatively loosely tied together, the intermolecular spaces being filled with "free carbon," which may be readily brushed out from a freshly fractured surface with a common whisk. In ordinary steel there is no free carbon, and the molecules are more closely united, hence the greater specific gravity of steel. The molecules of cast iron being far more mobile than those of steel tend to arrange themselves farther apart when the mass of molten metal cools slowly than when it cools rapidly, hence the more open grain; and tests show that the specific gravity of a mass of gray cast iron which has been rapidly cooled is always higher than the specific gravity of a mass of the same metal cooled more slowly. The denser the iron the higher is the tensile strength.

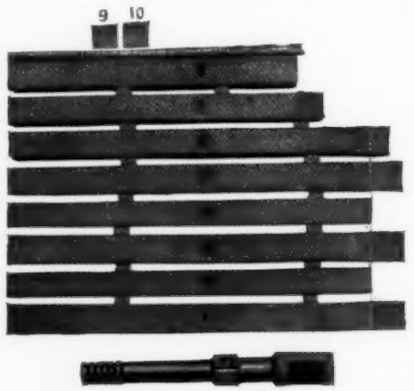


FIG. 2. BARS OF GRAY IRON ORIGINALLY OF THE SAME LENGTH.

My purpose in stating these facts, some if not all of which are, no doubt, well known, is to lead you by logical steps up to the consideration and comprehension of some recent observations respecting the mobility of molecules of cast iron, which, I venture to think, will prove both novel and surprising.

I now present for your close inspection two companion test bars which were cast from one ladle of iron in one mold, from patterns of the same dimensions, viz., 15 inches long and 1 inch square section. In order to avoid possible variations due to "rapping" of the patterns, the ends of the molds were formed by iron yokes, accurately machined to 15 inches between the ends of the yokes, inserted in the mold. (See Fig. 5.) When the bars were cleaned and measured they were found to be 14 13-16 inches long and 1 inch square section. One bar remains exactly as cast, *the other has been caused to grow gradually in cubical dimensions* until now it is 16½ inches long and 1⅛ inches cross-section! A portion of one side of this bar has been machined in order that you may examine the finished surface, and you will observe that, notwithstanding the surprising increase in bulk—exceeding 40 per cent. over the original dimensions—it has lost none of its metallic qualities and presents a beautiful lustre and fine-grained, smooth surface. This bar weighs precisely the same as it did before it had been caused to grow no less than 1 11-16 inches in length and ⅛ inch in cross-section, but the specific gravity is of course less than before.

You will naturally ask, having now examined the two bars: "How was this extraordinary increase in bulk produced while the metal remained in the solid state, retaining its original form, and showing no appearance of any alteration except in size?"

It has been accomplished by alternately heating and cooling the bar many times, and the great increase in size is a very striking corroboration, I think, of the theory advanced in the paper presented to the American Institute of Mining Engineers in 1896 of the mobility of the molecules of cast iron.

In my first experiments in making castings grow in cubical dimensions (which were made prior to the publication of that paper), some test bars were accurately measured and then imbedded in an open sand mold, forming, in fact, the bottom of the mold. The mold was then filled with molten cast iron of about the same composition as the bars and allowed to

remain undisturbed until cold. The bars were then removed, placed within the iron yoke and measured by inserting a hardened steel wedge, graduated to read readily to thousandths of an inch between the end of the bar and the yoke. All of the bars had increased in length, and after six repetitions, reversing the position of the bars each time in order to keep them straight, they would no longer fit into the space between the ends of the yoke, showing that they had expanded to the full length of the mold in which the molten metal was poured. In other words, the original shrinkage of the metal had been eliminated. This process was repeated many times, the bars continuing to grow both longer and thicker with each heating.

FIG. 3. PATTERN FOR A FLUE GRATING.

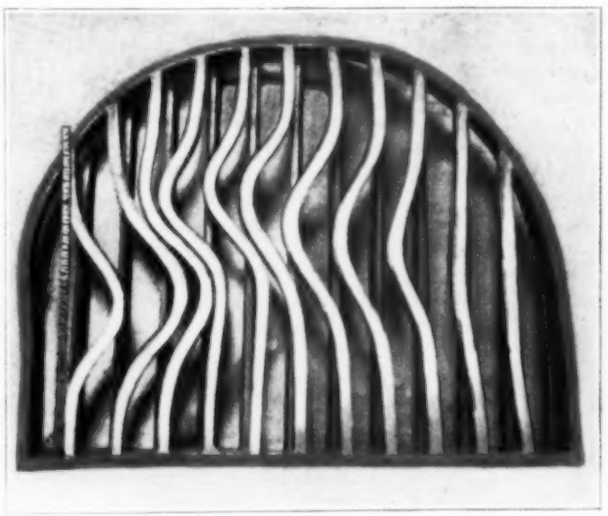


FIG. 4. CASTING AFTER REPEATED HEATINGS LAID ON PATTERN.

Tests were made to ascertain the effect upon the strength of the metal, and in all cases there was a marked decrease in strength amounting, in some instances, to 30 per cent.

In the recent experiments, where a much larger growth in cubical dimensions, as in the bars now before you, has been obtained, a different method of heating has been adopted, whereby a record has been secured of the temperatures, and it has been found that there is a certain "critical temperature" which produces the greatest degree of expansion per heat.

All of the bars now shown have been heated in a case-hardening furnace provided with a pyrometer. In order to prevent scaling, or oxidation of the surface, the bars were enclosed in an iron pipe, the ends being stopped with clay. The temperature was at first maintained at about 1,200 degrees Fahr. for one hour, the gas was then turned off and the pipe was allowed to cool slowly over night, the bars being removed and measured, when cold, on the following morning. It was found necessary to heat the bars nearly one hundred times in order to obtain an increase in length equivalent to about 1 inch per foot. Then the temperature was increased to 1,450 degrees Fahr., when a much greater gain in dimensions occurred, averaging about 1-16 inch per heat. The bar which has increased 1 11-16 inches in length and ⅛ inch in cross-section, has been heated twenty-seven times at this critical temperature. So far, there is no evidence of disintegration of the metal, and but slight change in structure is visible to the naked eye; the bars are smooth, straight and have sharp corners.

Specimens of the expanded bars having been polished, etched and examined under the microscope, a change in structure then became plainly visible. Mr. Job, the chemist of the Reading Railroad, has made some photo-micrographs of these expanded bars, and has kindly sent me a lantern slide containing two views; one of a piece of an untreated bar, the other a piece of the same bar after thirty-five heatings. (See Fig. 1.) He states in his letter that the dark lines radiating in all directions, which appear in the expanded metal, are spaces (cracks) between the crystals of iron, showing that they have been "pushed out in all directions when heated, and have not returned to their original positions when cold," thus proving, I think, that the increase in cubical dimensions of the bar is due to the movement of the molecules, and not to chemical changes or changes of crystalline structure. A careful examination of both photo-micrographs shows very similar arrangement of the crystals, the only material difference being that of contiguity of the iron particles.

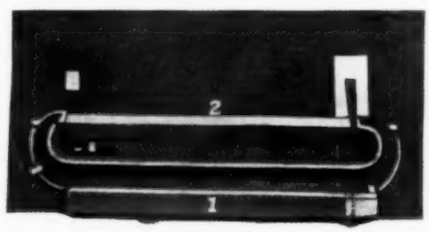


FIG. 5. YOKE FOR MEASURING TEST BARS.

We will now (see Fig. 2) show seven test bars of cast iron, all originally of the same length; two remain for comparison just as they were cast, while five have been expanded in different amounts, from 1 inch up to 1 11-16 inches in length, and from 3-32 to ⅛ inch in cross-section.

The same picture shows a bar of steel cut to 12 inches before treatment, heated and cooled in the same manner sixty-one times; this bar has shortened ⅛ inch, instead of increasing in length, as may be seen by comparison with the foot rule resting on the bar.

Other bars of steel of different grades, and also of wrought iron, all contracted about ⅛ inch to the foot under this heat treatment.

The same photograph also shows a section of a bar before treatment, and another of the same bar after having been expanded by repeated heatings and coolings (Figs. 9 and 10).

The question naturally arises, have these observations any practical value? It would seem, perhaps, at the first glance that the decrease in strength of cast iron due to the heat treatment would limit the field of usefulness of the expansion process, and even that it might remain a mere scientist curiosity. A little reflection will, however, show that a loss in strength, up to, or even more than, 30 per cent., is entirely negligible in many cases, and already some interesting practical applications have been made of this discovery.

No. 11 in Fig. 2 shows a piston of a small pump which had become worn so that it was too small in diameter for further use; this scrapped casting was rescued happily for experiment, and I was informed before commencing to enlarge the piston that the polished end (having five grooves) was 6-1,000 inch under size. I enclosed the piston in a piece of iron pipe and heated it five times, when, on remeasuring, it was found to have increased 45-1,000 inch in diameter, or more than seven times the amount required to bring it up to the original size. The picture

shows the piston just as it was taken from the tube after having been expanded by heat.

Fig. 3 shows a pattern for a casting intended to be used as a protective grating to be laid upon the floor of a core oven over the flue. Fig. 4 shows this same pattern, and in front of it is placed a casting made therefrom which has been in use several months, and has been heated and cooled many times. The casting was simply laid upon the floor of the core oven over the flue and not fastened in any way. The bars in the center of the casting were heated by direct radiation from an anthracite fire about 10 feet below the casting, and were therefore far removed from the flames. The outside framework and the ends of the bars resting on the floor were protected from direct radiation of heat, and consequently remained comparatively cool.

The heated portion of the bars increased in cubical dimensions, just as the test bars have done under similar circumstances, and as the bars could not grow in the direction of their length, being held in place by the non-expanding frame, they were compelled to take the curved forms shown in the picture.

It will be observed that the outside frame of the casting matches the framework of the pattern, but some of the bars, having the curved form, have grown longer, the left-hand bar, for example, from about 22 inches, as originally cast, to 24½ inches in length, and all have also increased greatly in thickness in the parts exposed to the greatest heat. As the foregoing tests have shown that steel bars do not expand under such conditions, it is proposed to have steel castings made from this pattern to replace the distorted iron castings, and it is expected that they will retain their original shape and size indefinitely. As these gratings do not come into contact with the fuel or flames, there will be little tendency to burning or scaling off of the metal. I do not know whether cast-steel grate bars have ever been substituted for cast iron, or whether the scaling would cause their too rapid destruction.

A New Plain Cleveland Automatic Screw Machine.

We give engravings of the latest addition to the line of Cleveland automatic machines, this being known as the 2¾-inch plain. Fig. 1 gives plan, side and end elevation of the machine, from which a very good idea of its general appearance may be had. The other views are of details showing recent improvements to be here described.

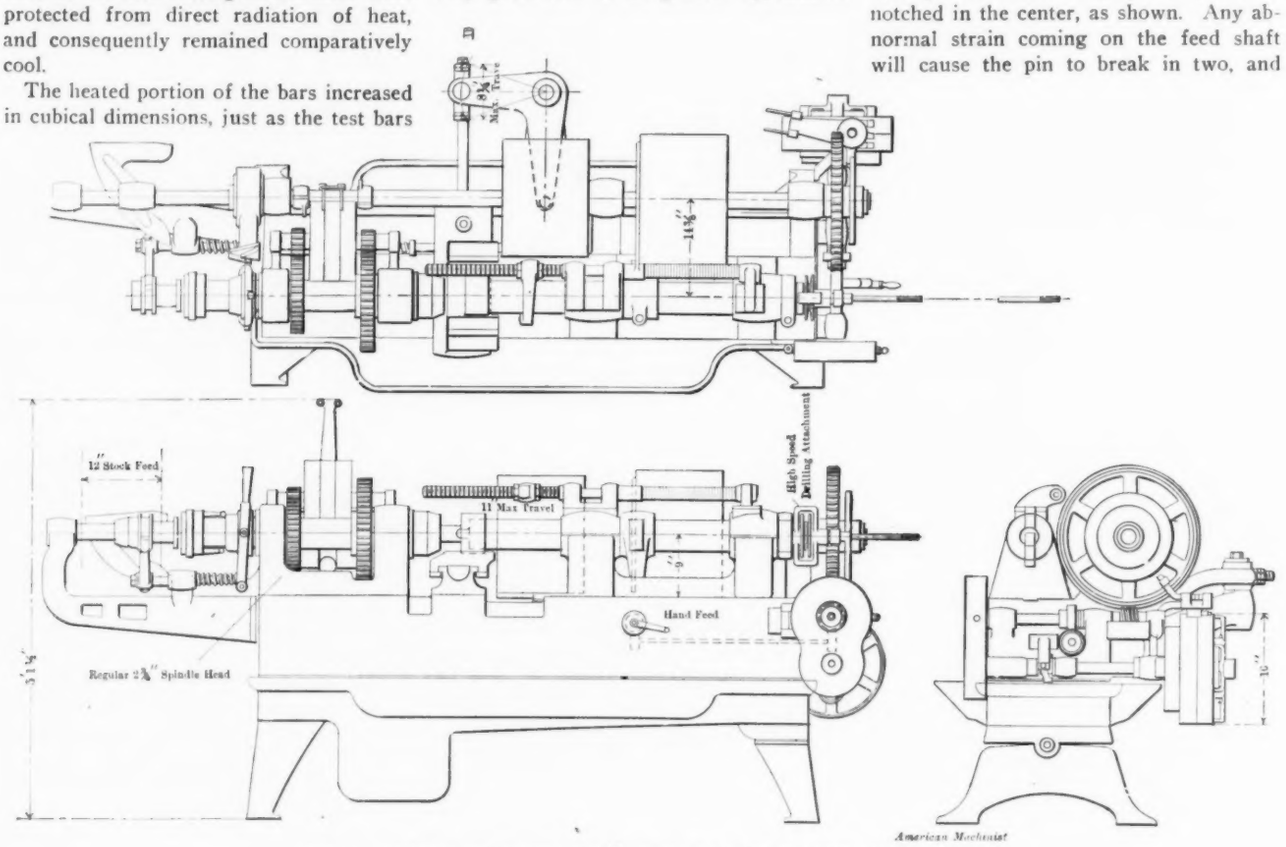


FIG. 1. GENERAL DRAWING OF 2¾-INCH PLAIN CLEVELAND AUTOMATIC.

The mechanism for obtaining the feed and high-speed idle movements is shown in Fig. 2. The operation of this mechanism is as follows: With the belt on pulley *D* the feed motion is driven direct at high speed for the idle movements; with the belt on pulley *C* it is driven through the train of differential gears *A B C D*, the sleeve *e*, ratchet pawl *f*, ratchet *g* and pulley *D*. A special feature of this mechanism is the pawl *f*. When the belt is on the pulley *D*, the pulley *C* and all the parts driven by it—*i. e.*, gears *a b c d*, sleeve *e* and pawl *f*—are independent of all the other mechanism, and consequently slow down and come to a stop. The friction which is set up between *g* and *h*, as a result of this, lifts pawl *f* out of the ratchet *g*. When the belt is shifted from the pulley *D* to pulley *C*, the opposite of the above described action takes place, and the pawl *F* is pulled down into ratchet *g*, and through this and the pulley *D* drives the mechanism at the feeding speed. The feed belt is shifted by the shifter *E*, operated by cams *F* on cam disk *G*.

The brake *O*, Fig. 2, acts on the pulley *D* just as the belt is being shifted to the pulley *C*, and retards it, thus preventing the high-speed idle movement from running ahead, which would in some cases be apt to jam the tools into the work.

The safety device is shown at *k*, Fig. 2. The pin is made of gray iron, and is notched in the center, as shown. Any abnormal strain coming on the feed shaft will cause the pin to break in two, and thereby stop the feed of the machine before any damage can be done.

Fig. 3 shows the high-speed drilling and centering attachment as applied to this machine. The sleeve *w*, which is the bearing for the drill spindle, is clamped to the tool spindle *A* by the set-screw *v*. The drill moves longitudinally with the tool spindle, and comes into action when the mill, which is clamped on the outside of the tool spindle, nears the end of its movement. The drill spindle is rotated by the pulley *s*, which is driven by a round belt from the countershaft. When setting up the machine to center a piece of work, the set-screw *v* is loosened and the drill pushed as nearly into the correct position as possible, and then adjusted by adjust-

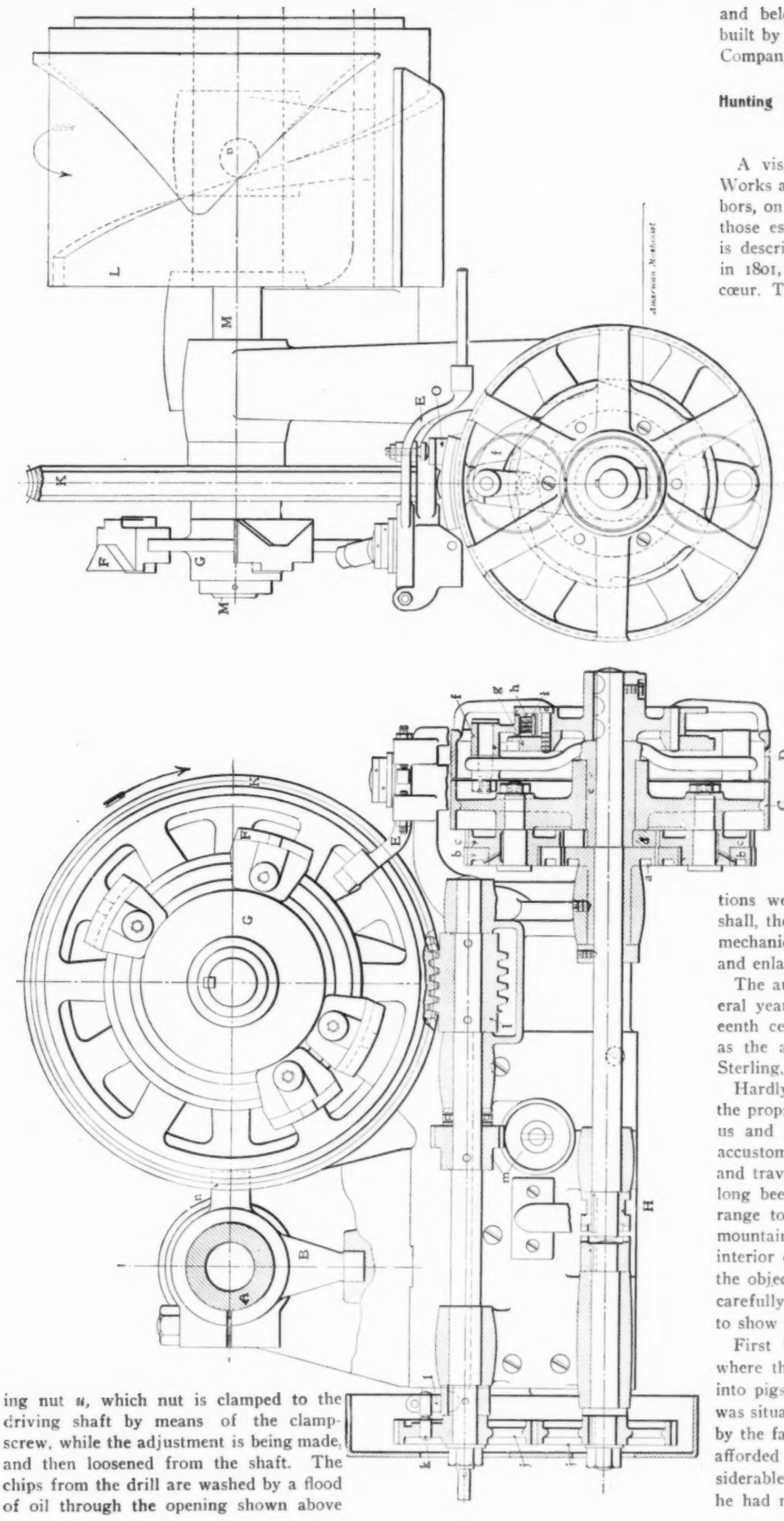


FIG. 2. FEED MECHANISM OF 2¼-INCH PLAIN CLEVELAND AUTOMATIC.

ing nut *u*, which nut is clamped to the driving shaft by means of the clamp-screw, while the adjustment is being made, and then loosened from the shaft. The chips from the drill are washed by a flood of oil through the opening shown above and below the drills. This machine is built by the Cleveland Automatic Machine Company, Cleveland, Ohio.

Hunting Ramapo Furnaces in the Eighteenth Century.

BY E. P. BUFFET.

A visit to the Sterling (N. Y.) Iron Works and some of its New Jersey neighbors, on a touring expedition, made while those establishments were in their prime, is described in a book published in Paris in 1801, by Hector Saint-John de Crèvecœur. That gentleman is sometimes spoken of as "Marquis," but it is not certain that he bore the title. He had served in America in the French and Indian War and afterward spent much time in this country. The book professes to be printed from a manuscript written by "an adopted member of the Oneida nation," and recovered from a shipwreck. There can be little doubt that the experiences narrated were Crèvecœur's own. An extract describing his inspection of the Sterling works has been quoted by Swank from a translation made by the late O. H. Marshall. Reference to the old French book shows that this excerpt omits several interesting particulars, including all about the visits to Ringwood and Charlottenburg. Whether or not these portions were ever translated by Mr. Marshall, they seem never to have reached the mechanically minded public. A revised and enlarged version is therefore justified.

The author's travels extended over several years toward the close of the eighteenth century. It is safe to assign 1790 as the approximate date of the visit to Sterling, described as follows:

Hardly had we stabled our horses before the proprietor, Mr. Townsend, approached us and received us with the air of one accustomed often to entertain strangers and travelers. In fact, his hospitality has long been so well known that people arrange to lodge with him in crossing the mountains between New York and the interior of the State. Upon learning that the object of our journey was to examine carefully his different works, he offered to show us all the details.

First he led us to his large furnace, where the ore was melted and converted into pigs of 60 to 100 pounds weight. It was situated near the principal dam, which, by the favorable position of the rocks, had afforded him at small expense a very considerable reservoir. From a mere brook he had made a little lake of 15,000 acres

surface [see notes] filled with fish, on which he had a pretty boat. The furnace blast was furnished by two immense wooden blowers, 48x7 feet, neither iron nor leather being used in their construction. The violence, the noise of the wind that they made, resembled a tempest. This furnace, he said, produced from 2,000 to 2,400 tons [tonneaux] annually, when there was no accident, three-fourths of which was converted into bars, the rest melted into cannon balls, cannon, etc., for commercial purposes. . . .

Thence we went to see the refinery [or rather, forge]. Six large hammers were engaged in forging iron bars and anchors and various pieces used on vessels.

Lower down, on the same stream, was the foundry, with its reverberatory furnace. He called our attention to several ingenious machines for different uses. The patterns [or models] had been sent him and they had been cast with an ore [literally, with a *potin*, pinchbeck, which would seem to imply a brassy composition] recently discovered in these mountains, the grain of which, after two fusions, acquired the fineness and almost the color of tin.

"With this," he said, "I can do the lightest and most delicate work. What a pity that you did not come here eight or ten days earlier! I would have shown you first three new kinds of plows, the principal parts of which I have cast and which still are no heavier than the old-fashioned. Each is provided with a kind of graduated steel-yard by which one can tell with precision the tractive power and soil resistance. Second, there was a portable mill for separating the grain from the chaff. There was yet another invention by means of which all the ears of grain of a field may easily be gathered without necessity of cutting the stalks at the root to make it into sheaves, as formerly. All this has started for Mount Vernon, for," he continued, "General Washington....directs the cultivation of his immense estate with a discernment and an attention worthy of eulogiums."

From the furnace we went to see the ovens in which the iron was converted into steel. "It is not yet as good as the Swedish," said Mr. Townsend, "but we are approaching the latter. A few years more and we shall attain perfection. The iron from under my hammers has long borne a good reputation, and it sells from £28 to £30 per ton [tonneau] of 367 to 390 pounds weight.* [See notes.]"

After having passed two days in examination of these various structures and in admiration of the art with which he had utilized the flow of the waters, as well as the order and arrangement of the wood-cutting for charcoal, which involves considerable enterprise, we quitted Mr. Townsend, and the same day arrived at Ringwood. The proprietor of these works, Mr. Erskine, had, as we knew, spent three years in Europe, visiting the principal forges of Scotland, Sweden and Germany. His operations, although less extensive, seemed to us no less interesting. The construction of the different machines intended to simplify the work was even more perfect than what we had seen at Sterling. A large *movement* for flattening and slitting the iron into rods appeared to Mr. Herman a *chef d'oeuvre* of simplicity, but what rendered it yet more curious was the flour mill by which it was surmounted, and which could be lowered when it was wanted for use and raised when the grinding was finished. All these pieces were of pinchbeck [*potin*]. Not far away was another machine designed to bore guns [or cannons]. Mr. Erskine told us that he sold in an ordinary year 500 tons of bar iron and 200 of steel, not to speak of cast iron; but Ringwood, beside the abundance of its waters and wood, enjoyed an inestimable advantage in being only a short distance from the Hackensack River, which empties into the great bay of New York.

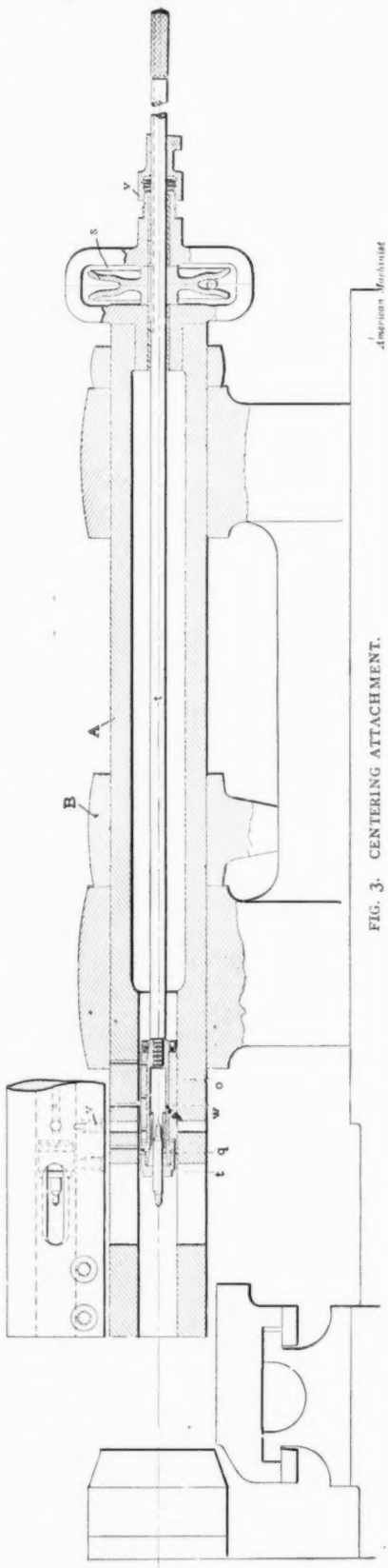


FIG. 3. CENTERING ATTACHMENT.

[Regarding the forests in this part of the country, Mr. Herman remarked to Mr. Erskine] "If your posterity preserves these beautiful woods it will for many centuries enjoy the precious advantages of having the charcoal necessary for making iron, facilities for repairing buildings and dams, and all the power required."

"You are right," said Mr. Erskine. "It is probable that this will come to pass, since the entire chain has long been the property of a few individuals extremely interested in the preservation of the forests. From the borders of Connecticut to those of New Jersey [inclusive?] there are numbered in these mountains seven furnaces and six large forges, not to mention foundries and several refineries [or forges] which produce annually, say, 140,000 hundredweight of wrought iron, much steel, anchors, cannon [or gun barrels], etc."

Next day we came across a very mountainous country to Charlottenburg. The works here had been erected before the Revolution by an English company which the war had ruined. The furnace . . . proprietor was absent. We saw here a nail mill much improved by means of a large number of little hammers driven by power from outside. Here were forged bolts, as well as several other kinds of iron-work for marine use. We observed also a mill for sheets and iron plates used in making spades and shovels. Here, as at Sterling and Ringwood, the water reservoir was immense. It was stated that the year before 46,000 hundredweight of pig iron had been smelted.

From Charlottenburg we proposed to visit Bellvale, but learning that nothing was to be seen there except big hammers, we abandoned this project. . . .

Notes.—The brilliant imagination of Crèvecœur's race is evidenced by his estimate of the lake at Sterling as 15,000 acres in area. Evidently he had partaken too freely of Mr. Townsend's "hospitality." Assuming that the body of water referred to was the main Sterling lake, which is probable—and it could hardly have been much larger—a fair estimate would not have placed it far above 100 acres. Perhaps the word "acres" is a misprint for "ares." Further, it may be questioned

*A ton weighs 2,200 pounds.—Foot note in the French book.

whether the lake is of artificial construction, although very possibly the size was increased by damming. In that part of the country great reservoirs were indeed formed for industrial purposes. After Peter Hasenclever, founder of the American—also called London—Company, which controlled Ringwood, Charlottenburg, etc., fell into financial trouble, a committee appointed by Gov. Franklin, of New Jersey, to investigate his affairs in a friendly way, and consisting of Lord Stirling, Col. John Schuyler *et al.*, reported in 1768: "He is the first person that we know who has so greatly improved the use of the great natural ponds of this country, as by damming them to secure reservoirs of water for the use of iron works in the dry season, without which the best streams are liable to fail in the droughts we are subject to." One of his dams was 860 feet long. In recent years several enormous reservoirs have been constructed in Northern New Jersey to supply water to cities in the metropolitan district. At the present time a new dam, built to store up the Rockaway river for many miles, near Boonton, has been put into service, and it is said that the site of the famous colonial iron works of Ogden and Faesch has been submerged. Interesting information about the accumulation of waters in Southern New York could doubtless be obtained from the Ramapo political grafters.

The foot-note in the French book giving the weight of a ton, is apparently intended to correct an error in the text. Perhaps if we translate *tonneau* as tun, cask, it might justify the language, but the English word ton, meaning a weight, used sometimes to be spelt tun, and Crèvecœur seems elsewhere to employ *tonneau* interchangeably with *tonne* as a weight. The £'s above are not certainly £'s Sterling, but may have been reckoned in an American currency of lesser value. American bar iron was quoted in Philadelphia, November 9, 1790, at £29 to £30 per ton (Pennsylvania money?), which seems to agree with Townsend's price. The value at about this period is also estimated at $80 per ton, as compared with an average of $64 before the Revolution.

The Mr. Erskine found by the author at Ringwood could not have been Robert Erskine—for he had died in 1780—but was presumably a son of that distinguished ironmaster.

The reference to the grist mill over the slitting mill is especially interesting for comparison with the tradition of Samuel Ogden's slitting mill at old Boonton in the days when such establishments were under a Parliamentary ban. It may be remembered that the second story, fitted up with a grist mill, was so arranged as to serve for a blind when the Governor came to investigate.

By the "English company" which Crèvecœur states as having built the furnace at Charlottenburg before the Revolution, he probably means the American, or London, company of Peter Hasenclever. The latter became involved—partly, at least, through the misconduct of a partner—in 1766 and was declared bankrupt about three years later. His failure was an incident common to the careers of early American ironmasters. He was eventually justified in his conduct by Lord Thurlow, in England, and later became so successful as a linen manufacturer in Silesia that he declined a good offer from Benjamin Franklin to return to America. There is some evidence that the company survived him in the iron enterprises and continued with Robert Erskine as manager. Apparently the ownership of the Ringwood and Charlottenburg works had separated before Crèvecœur visited them.

By "Bellevale," he may refer to Bloomingdale, which is situated on the Pequannock, not very far from Charlottenburg. Ryerson's forge—a later-built affair—was still standing there in the last decade. The name, however, suggests Belleville, near Newark, the seat of an early copper industry, which is still carried on.

Hardening Drop Dies.

BY E. R. MARKHAM.

In a recent issue of a trade journal a reader asked for a satisfactory method of hardening drop-forging dies. An extended experience on this and similar lines of work leads me to say that no single method can be followed. It must vary according to the stock in the die, its size and outline, the work it must do and the working conditions.

It was formerly considered necessary to make all forging dies requiring to be hardened from crucible tool steel, but experience has proved that for certain classes of work a good grade of open-hearth steel of the proper carbon gives results which justify its use. In some shops this steel is used altogether, but the results are not altogether satisfactory for dies with small projections or for shapes that weaken the die.

There are various makes and grades of both open-hearth and crucible steel, and a make which gives satisfaction in one shop does not in another.

When heating for hardening, some hardeners place the die in the furnace *face down* on a layer of powdered charcoal; this is supposing that we are using a furnace where the die does not come in contact with the fuel. I know a hardener who gets excellent results heating in charcoal in an open fire, built specially for the purpose; I have had best results, however, when heating in a furnace—a case-hardening furnace works nicely—the die being placed in a box having an inch or so of wood charcoal or charred leather, preferably the latter, in the bottom. The box should be shallow, so as not to come up on the side of the die more than 2 or 3 inches when it is resting on its bed of charcoal or leather.

The heat should be applied strong enough to heat the die as rapidly as possible consistent with uniform heating, and no faster or some portions will become overheated, and this will cause strains which may cause the steel to crack when hardened.

As there is a tendency to heat the beveled edges of the tang more rapidly and to a higher heat than the rest of the block, it is good practice to fill in the corner with fire-clay mixed with water, allowing it to dry before placing in the furnace.

When the die is uniformly heated to the proper heat, remove the box from the furnace, remove the fire-clay from the corners of the tang. In order to keep the tang from humping when the die is hardened, it is best to stiffen the tang before hardening the face; this is done by placing the die on wires in the bath *tang down*, so that the water is projected against it. While this portion is cooling, the corners of the die may be slapped with a wet cloth to cool them somewhat before hardening the face. Any very delicate projections that are liable to cause trouble may be oiled or rubbed with soap to prevent the water acting too quickly on them.

When the tang has cooled so that no red can be seen, the die should be inverted and the water allowed to play on the face. At the same time water should be poured on the tang until the red has disappeared from the face, when we should cease cooling the tang and allow the heat in the center of the die to run out through this portion.

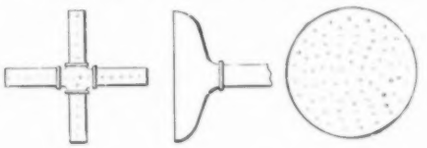


FIG. 1 FIG. 2

American Machinist

COOLING JETS FOR STEEL HARDENING.

The overflow in the tank should be so regulated that the water will only come up on the face of the die about an inch; of course it will be forced up the sides of the die by the flow of the water in the supply pipe.

The pipe delivering the water to the die should distribute it directly against the whole face, rather than in a solid stream, striking all in one place. Make the top of the pipe in the form of a +, as shown in Fig. 1, or a perforated top to the supply pipe, as shown in Fig. 2, is excellent.

In winter some means should be provided for removing the chill; this can be done by entering a steam pipe into the supply, when any desired degree of heat may be obtained.

To eliminate so far as possible the tendency of the steel to crack from internal strains set up by the process of cooling, the die should be so heated as to promote

this result. Some hardeners think it advisable to do this by drawing the temper. This seems to work all right if the heating is done slowly enough for the heat to penetrate to the center of the block; but if the heating is rapid this result is not accomplished, the strains are still in the steel and may manifest themselves at any time. The die may crack after being placed on the shelf, or it may not until some time after.

Knowing the tendency of large pieces of hardened steel to crack from the cause mentioned, it is best to take every precaution to prevent it. A very inexpensive method consists in placing the hardened die in a water tank which has a steam pipe connected with it. Steam is let in and the water is *gradually* heated to the boiling point and kept there for several hours, when the dies may be removed and the temper drawn. If it is not thought advisable to use this method, place the die where, to insure uniformity of heating, it will heat slowly, and continue the heat until when touched with moistened finger a snapping sound is heard. In order to effectively avoid the tendency to crack from internal strains, the heating must be slow enough to insure the penetration of the heat to the center of the piece.

It is often desirable to draw the temper immediately after the hardening; when this is the case the greatest possible care should be exercised. A die having slender projections or light, irregular portions, if heated faster than the steel can absorb the heat uniformly, will of course become hottest at the lighter portions, and these expanding faster than the solid portions adjacent will tear themselves away. Where there are such light projecting portions it is often advisable to fill the surrounding depressions with oil; this will prevent a too rapid heating of the parts and stop their "snipping off."

Sometimes, and for certain work, it is not necessary to harden the dies, but it is still often advisable to stiffen the steel somewhat under such conditions. The die may be heated and then cooled in oil. A bath of generous proportions should be used having a jet of oil coming up from the bottom, this striking the face materially aids in producing the desired effect.

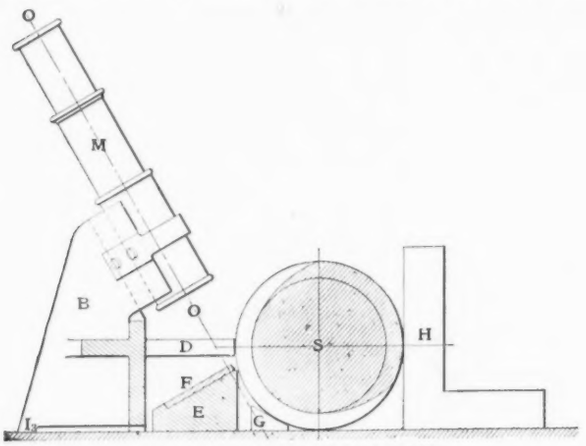


FIG. 1 CROSS SECTION OF SCREW AND MEASURING APPARATUS

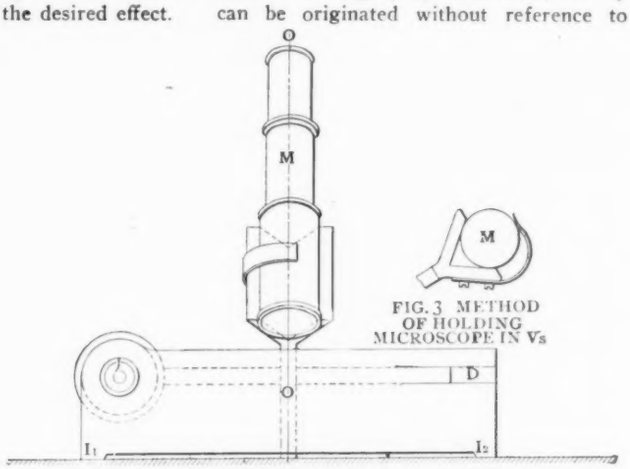


FIG. 2 ELEVATION OF MICROSCOPE CARRIER

FIG. 3 METHOD OF HOLDING MICROSCOPE IN Vs

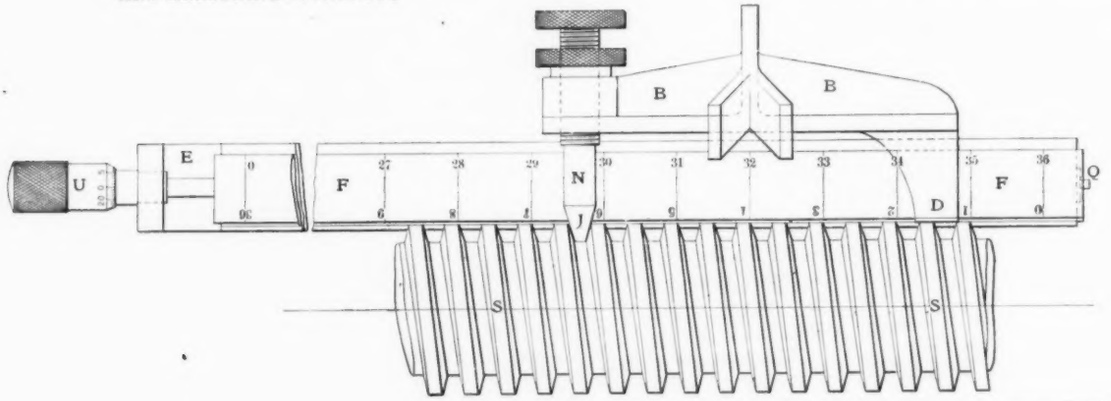


FIG. 4 PLAN OF SCREW MEASURING APPARATUS

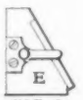


FIG. 5 END VIEW OF SCALE

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While open-hearth steel which contains a sufficient amount of carbon works well on many dies, its use is not advocated for dies that must be very strong or that should retain their sizes, as cold-drop dies. A good grade of crucible die steel containing a higher percentage of carbon can be used, which will harden much deeper and harder than the open-hearth of lower carbon.

The crucible steel, being lower in percentage of harmful impurities, can safely have a much higher percentage of carbon and yet be less liable to crack than the open-hearth material.

After all, the real essential for successfully doing work of this character is *brains;* it is necessary to discriminate between dies of different sizes and shapes, and to judge of other conditions, and then act accordingly.

Determining the Errors in Screws.

BY ROBERT A. BRUCE.

The majority of mechanics are occupied in copying forms and surfaces previously originated, the task of generating such standards being undertaken by a chosen few. The actual origination of a standard of any kind is a far rarer act than is commonly imagined. The most common primary standards are surface plates, straightedges, squares and certain angular gages such as the 60-degree triangle. These stand in a category by themselves, as they can be originated without reference to other standards. In conception, at any rate, and within the limits of manipulative skill and patience they can be at any time generated anew.

Standards involving the use of a fundamental unit belong to a different class, as they cannot be originated, but must all be derived from the original, or some copy of it. A screw of uniform pitch the measure of which did not conform to any particular standard might conceivably be independently originated, its errors being detected by means of a comparator and a dividing wheel (itself absolutely generated), subsequent corrections bringing about a nearer and nearer approach to accuracy. A screw to be serviceable should,

however, have a pitch which bears some simple ratio to the fundamental unit in common use. It is in the necessity for combining uniformity of pitch with conformity to standards of length over its whole range that the difficulty of attaining accuracy in screws consists. It is hardly surprising, therefore, to find that leading screws, though perhaps the most frequently used standards or patterns from which other surfaces are produced, are comparatively seldom verified and still less often corrected The elements of accuracy which must be possessed by a true screw are as follows:

The axis must be linear—in other words, the screw must be straight; the tops and bottoms of the threads must be truly cylindrical—that is to say, the bar must be round and of uniform diameter, and the spaces must be of uniform depth; the sides of the thread must be of uniform shape, and finally the pitch must not only be uniform but must bear some definite relation to the standard of length. It is of little use to be able to demonstrate that any one of these elements of accuracy is absent. It is necessary to find out what the errors amount to. There is little difficulty in detecting and measuring errors in straightness or deviation from roundness, nor are errors in the form of the thread likely to give rise to trouble until measurements of considerable refinement are undertaken. The measurement of errors in pitch is, however, troublesome the moment that it becomes necessary to state them in positive terms. Some modification of the following method for tabulating errors in long screws may therefore be of service. In undertaking any measurement it is necessary at the outset to have clear and definite ideas as to the approach to accuracy which is necessary. The method to be described was designed for the workshop and does not lay claim to the greatest obtainable accuracy. It is deemed capable of enabling a careful but not specially skilled or trained operator to tabulate the pitch errors of a screw 10 feet long and obtain results well within .0005 inch of consistency. That is to say, any corresponding values of the two series of measurements should certainly differ by less than .0005 inch and the limits of accuracy of any one measurement should be .001 inch. Thus, if the measurement from the first to the hundred and first thread is read as 50.005 inches the true measurement is not less than 50.0045 inches nor greater than 50.0055 inches. It is hardly necessary to point out that these limits, gross as they might appear if applied to the measurement of a small micrometer screw, are tolerably precise when laid down for screws 10 feet long or more.

The screw S to be measured is compared with a scale by means of a small microscope provided with cross hairs which is mounted on a light portable support provided with a conical bolt of suitable shape and capable of insuring a definite relationship between the side of the thread being measured and the optical axis of the microscope. The arrangement is best understood by referring to Figs. 1 to 5. The screw is laid on a surface plate or other true plane and held in position by small wedges G and angle plates H, so that its axis lies in a straight line. A long block E, shown in section in Fig. 1, carries a scale F which can be moved endwise for a limited distance by turning the milled head U of the micrometer, placed at the left of E in Fig. 4. A spring Q, seen on the right of the same illustration, presses the scale against the measuring screw so as to take up backlash and constrain the whole scale to move with it a distance which can be read in the usual manner by the graduations on the micrometer head. The block E is placed so as to touch the screw throughout its own length; the parallelism of the axis of the screw and the scale being thus insured. A carrier B supports in a V-groove a microscope M whose optical axis $O\,O$ falls just within the edge of the scale next the screw. The position of the carrier B with reference to the screw is determined by means of the conical adjustable bolt N whose point J touches the side and bottom of the thread measured. A projecting rib D, in conjunction with the conical point J and the three supporting feet I_1, I_2, I_3, insures that the relative positions of the optical axis $O\,O$ of the microscope and the sides of each successive screw thread, against which J may be pressed, remain unchanged.

The method of proceeding is as follows: The carrier is placed so that J rests against the side and bottom of the first thread. The block E is then so placed that the first graduation lies within the field of the microscope and the micrometer head is then turned so that the cross hairs intersect the first graduation of the scale. The reading of the micrometer is then noted and J is entered into the next thread or the nearest one for which a reading is desired. If the pitch is correct, the intersection of the cross hairs will coincide with a graduation; if not, the micrometer head is adjusted to insure coincidence and the reading is taken. In this way a series of readings are obtained, and by subtracting the initial reading from each in turn a series of errors in positive terms is obtained. When the end of the scale is reached, the block E must be shifted endwise. Let us suppose that the microscope is in the correct position for reading the last division of the scale and that the micrometer adjustment has insured coincidence. By carefully moving block E, leaving the carrier B undisturbed, it is possible to bring the first graduation of the scale into coincidence with the cross hairs, when a fresh series of readings for the second scale length of the screw may be taken. By shifting the block and scale without disturbance of the micrometer, no additional correction is required for the fresh readings. The scale used for the purpose must be finely and very accurately divided, and, when obtained from an instrument maker, should, if means for an accurate verification are not at hand, be sent for examination to some competent authority. The scale used by me was rather over 36 inches long and had thirty-seven finely ruled lines spaced 1 inch part, so as to measure any integral number of inches from 1 to 36. It was examined by the Standard Department of the Board of Trade and was found to contain no errors greater than .00025 inch, the direction and amount of such errors being noted in the certificate furnished. By the method described the chance of cumulative errors is minimized, the number of shifts of the scale in reading errors over a 9-foot length of screw being only two.

Leeds, England.

Charge for Power at the St. Louis Exposition.

Soon after the organization of the Machinery Department of the St. Louis Exposition we suggested that operative exhibits should be encouraged by furnishing power free to exhibitors. We were led to believe that this would be done and announced in February that "The Director of Works and the Director of Exhibits in their discretion are authorized to furnish gratuitously to exhibitors a limited amount of power for the operation of machines and processes."

This statement, which emanated from the Exposition authorities, was understood to mean that power would be furnished generally in amounts sufficient to operate desirable exhibits and that the demand for space under those conditions was such that only the most desirable exhibits could be accommodated. It is of course subject to the interpretation that power would be furnished gratis only in exceptional instances, and this is evidently the management's interpretation, for exhibitors have been notified that there will be a flat charge of ten dollars per horse-power per month based on the motor capacity installed by the exhibitor and irrespective of the amount used.

We cannot but believe that this is a change of front on the part of the management, and that the original intention was to furnish power free in any reasonable quantities. This is certainly what we were led to believe, and it appeared the more reasonable that in all the recent expositions the difficulty has been, not lack of power, but lack of load to enable the engine exhibitors to keep their machines in operation under favorable conditions. Much of the power required to generate current for the lavish electric illumination of the grounds and buildings should be available for running exhibits in the daytime with the advantage of allowing some of the large generating units to be run loaded for the benefit of visitors during the daylight hours.—*Power.*

Letters From Practical Men.

Trucking a Heavy Machine Twenty-five Years Ago.

Editor American Machinist:

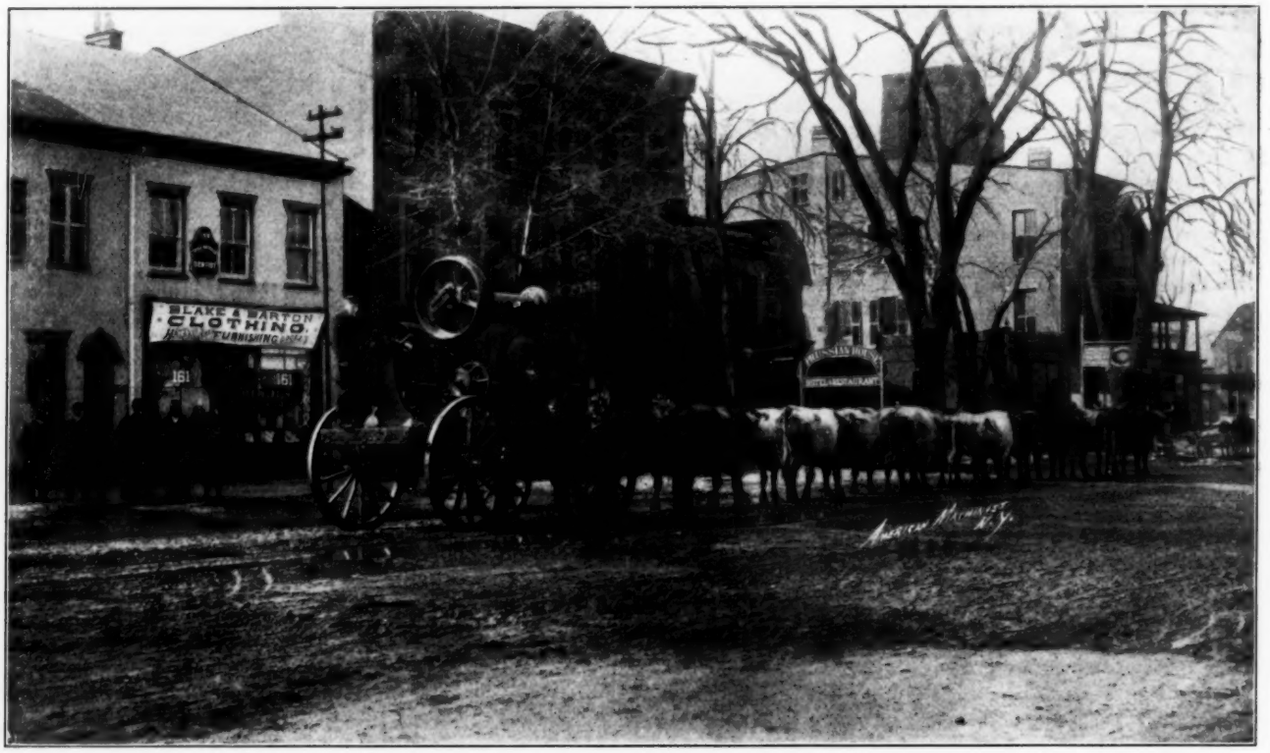
A few days ago while walking down Main street in Middletown, Conn., my thoughts wandered back to the days when there were no street cars in the old city, and when the streets were not in as good a condition as they are now. There was in this city a well-known machine shop in which from 1873 to 1877 I served my apprenticeship at the machinist's trade. Having a desire to become something more than a common lathe or planer hand, I put my attention to the study of drawing and designing such tools and machines as were built in those shops. My evening and spare time was largely spent in this way, and as I became more expert at the business the superintendent found out that I could do some drawing, became interested in me and encouraged me to design and build a small engine, allowing me to go to the factory evenings and holidays to work on it. As time passed on the superintendent would frequently call me to his office and set me to work doing some drawing for him during the day; this I considered a great favor as well as a pleasure to me. About this time I had completed my apprenticeship and become a journeyman machinist, working at the trade about three years, doing some drawing and machine designing, acting occasionally as a gang boss and after a time becoming foreman of the room. Another change was made in the works and I was put into the drawing office, where I remained about three years. While in this position I designed and built the largest power press that had been built by the company up to that time (1879). This press had a large automatic feed table and index feed attachment for punching perforated sheet metal.

After completing this press it was carefully tested and made ready for shipment. Here the question came up as to how to truck so large a press, weighing about 18,000 pounds, to the railroad—about a mile and a half. The haul was to be made over poor roads which had never before had such a load. The regular factory two-horse team could not haul it; the wagon tires, being too narrow, would sink deep into the road bed. Again, to attach horses enough to this load would simply mean the constant breaking of straps and harnesses, as horses such as we could get would be too jerky, as several short but steep hills had to be climbed. It occurred to our truckman that if we had a heavy wagon with wide tired wheels and a slow, steady-pulling ox team we could get this machine to the station possibly without any mishap. We at once decided to engage a heavy truck with six yoke of strong oxen which were used at the Portland brownstone quarries for their heavy work. On to this heavy wagon we loaded the press, and when all was ready the six yoke of oxen were carefully started by the six drivers. The huge load moved along as easily and as steadily as if on a smooth plank. While passing up the main street this novel team and its load attracted a great deal of attention, and as we arrived in front of a photograph gallery the artist asked us to halt and allow him to take a picture of this unusual sight, which we gladly did on the promise of a copy when done, and the photograph from which this half-tone is made was the one I received. It was laid away so carefully that I had nearly forgotten all about it, until I came across it while looking over some of my old shop sketches and photograph collections of bygone days.

After the successful moving of this large machine, we often used this means of conveyance, and many a heavy press or large drop anvil was taken to the railroad station in this way and always landed there in safety.

F. C. FLADD.

Brooklyn, N. Y.



TRUCKING A HEAVY MACHINE.

Hemp Packing for High Pressures.

Editor American Machinist:

Some time ago you had an inquiry from a man asking for information in reference to the limit of pressure that could be used for hemp packing—that is, where the change should be made from hemp packing to leather "U" packing.

Some people believe that for over 2,000 pounds pressure you should use "U" packing. I know of several cases where they are using hemp packing for 4,000 pounds pressure, but do not know what the loss is in friction compared with the "U" packing, when the rams are coming back with no load. If you have any information pertaining to this, or if you can get any through the columns of your paper, you will oblige. I have looked through the last seven years' volumes, but cannot find anything pertaining particularly to this question.

"INQUIRER."

Machining a Gas Engine Piston.

Editor American Machinist:

I have read the article on "Machining Gas Engine Pistons," at page 155, and think it a very good idea. As every machinist and foreman knows that in different shops you will find different ideas for doing the same piece of work, and as I have had considerable experience in that line of work, I thought I would send you drawings of the tools I have found to give very good satisfaction. The driver *A*, Fig. 1, is of machinery steel, threaded to fit the lathe spindle. The taper at *a* is turned at an angle of 7 degrees; the nose of the driver at *b* is about 3 inches in diameter and flatted on the sides in the shaper or miller. The piston is first chucked and the open end is bored to the same taper as the driver at *a*, and then placing the piston on the driver, as the taper is long it holds the piston very firmly, and it can readily be centered with an Almond chuck and a combination drill and center, the shank of the chuck fitting the taper in the tailstock; or you can use a common lathe centering tool. After turning the piston to the required diameter, the gang grooving tool, Fig. 2, is used. It is a block provided with two sets of cutters, roughing and finishing. It is held in the tool-post slide by the central bolt. After roughing the grooves the block is turned around until the finishing cutters come at right angle with the piston.

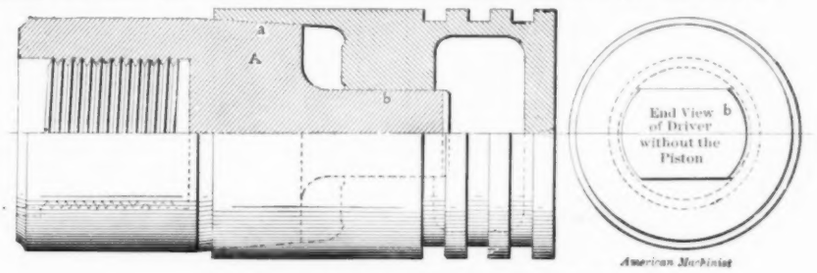


FIG. 1. DRIVER OR ARBOR FOR TURNING PISTON.

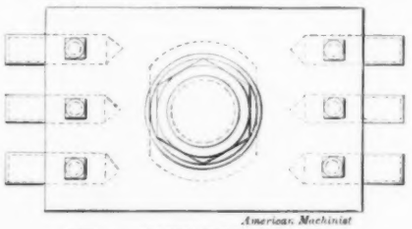
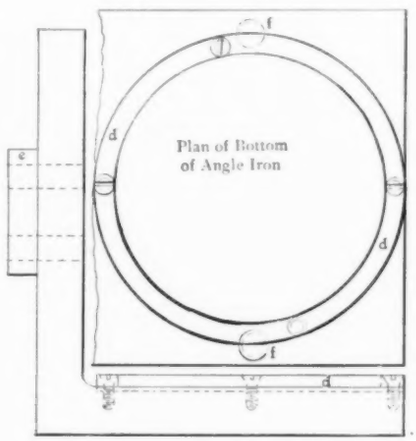


FIG. 2. GANG GROOVING TOOL.

For boring the wrist-pin hole the angle-iron, Fig. 3, is used. It is planed square and then it is recessed 1-16 inch deep to receive the ring *d*, the ring being bored to receive the piston. The angle-iron is then bored for bushing *e* the proper distance from the bottom of the recess to bring the centers of the wrist-pin bosses in correct position. The lathe face-plate is recessed to receive the enlarged parts of the bushing, and the angle-iron is fastened to the face-plate by two bolts, not shown.

The piston is held in position by two long studs *f f* and a strap *g*. By using a little care when setting the piston, the wrist-pin hole will come very near the center of the bosses. For centering or starting the holes, which are drilled out of the solid, an Almond chuck is used in the tailstock with a large-sized combination drill and center. The holes are first drilled about 1-32 inch under the finish size. If the taper hole in the tailstock is too large a collet is used; then an adjustable boring tool is put in to true the hole and leave a very little stock for the sizing reamer to take out.



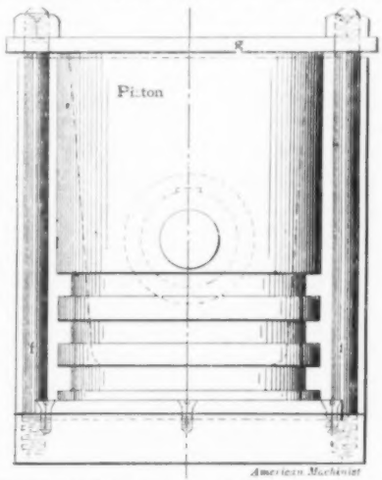


FIG. 3. ANGLE FACE-PLATE USED IN BORING FOR CROSS-PIN.

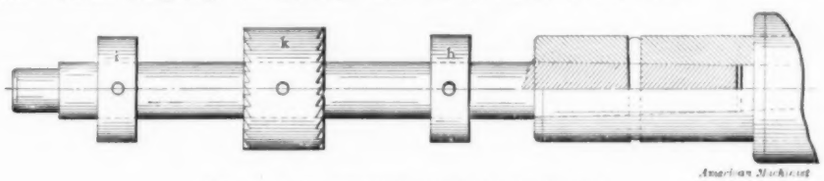


FIG. 4. TOOL FOR FACING INSIDE SHOULDERS.

For facing the bosses the tool shown in Fig. 4 is used, with a small taper cross-pin to hold it in the tail spindle. The collar *p* is fastened to the bar by a set-screw (headless) and serves as a stop. The double facing cutter *k* is set at the required distance from stop *h* and is held in place by a taper pin, as is also stop *i*, and the end of the bar is turned to fit bushing *e*.

The tools should be made as short as possible to avoid spring. The angle-iron for the cross boring is made for the largest size pistons we make, and is used for all smaller ones by simply turning a plate to fit the recess shown in Fig. 3, and the plate is recessed to receive the smaller piston, the plate being left the required thickness to secure the right hight from the closed end to the center of the wrist-pin.

OREL B. FRENCH.

Name and Number Plate Patterns.

Editor American Machinist:

In making name and number plate master patterns, where pattern letters cannot be used, it will be found that in place of carving the letters and figures out of wood or metal, ordinary beeswax is vastly superior to either by reason of the ease with which it can be shaped.

Recently it was necessary to make a master pattern of a name plate in *fac simile* of the signature—in this case a most fearful and wonderful scrawl—of a well-known business man. Beeswax was built up 1-16 inch high, 1¼ inches wide and 5½ inches long on a stock name-plate pattern 1-16 inch thick. The signature was then "forged" as closely as possible, and the surplus stock was roughly removed, leaving the letters heavily outlined with some stock still to be cut away by the finishing operation which brought out the desired result quickly and neatly.

The tools used were an old screwdriver heated by a gas flame to "build up" the wax, and two pieces of ¼-inch wood dowel stock each about 6 inches long, with one of the points formed triangular and the other like a round-nosed turning tool. By keeping the points of these wood tools well smeared with machine oil the wax was molded and errors were corrected with astonishing ease. A thin coat of shellac completed the job so that a brass casting for use as a permanent pattern was

made. This in turn was finished by passing a chipper's scratch-brush over the surface rapidly, thus avoiding the usual scraping and filing that old-timers are apt to kill time and profits by.

Paraffine wax is not suitable for this class of work, as it does not unite when cold as beeswax does. If a job such as described should be called for during the summer months, when beeswax is apt to be soft, a little rosin should be added, thoroughly stirring it in when the wax is melted.

W. H. PARRY *alias* "OLD BOB."

Some Special Calipers and Some Makeshifts With Regular Calipers.

Editor American Machinist:

Fig. 1 shows a pair of calipers designed to obtain the root diameter of inside threads and they are immeasurably superior to the old method of crossing the legs of a pair of outside firm joint calipers to get this measurement, as these can be run down into a thread several turns, which is a great advantage when the piece calipered may have been used considerably and worn bell mouthed. I think if the tool is made as shown, like the regular sensitive adjustment transfer caliper, there is much time saved in removing them from the thread.

Fig. 2 shows a pair of calipers of the same construction as Fig. 1, except that the points are formed round like a ball for "sizing" inside threads. These are a surprisingly handy tool when cutting a number of pieces in practical duplication, often doing away with the necessity of making a male gage, as it is a well-known

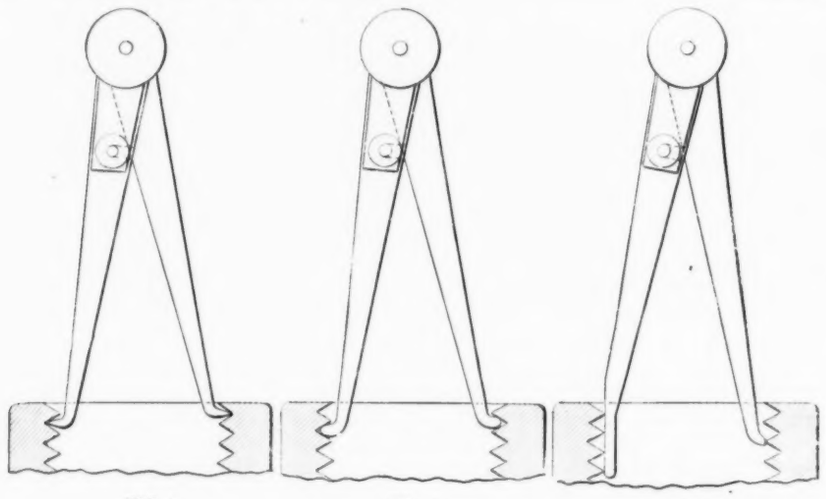


FIG. 1 FIG. 2 FIG. 3

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CALIPERING INSIDE THREADS.

fact that a thread can be sized most accurately at some point between the root and top.

Fig. 3 shows a pair of calipers designed to get the diameter of the top of inside threads in cases where it is necessary to make one inside threaded ring to duplicate another. By the use of calipers shown in Figs. 2 and 3 it is possible to very closely duplicate inside threads of a known angle, although of course in *accurate* gage work other methods must be employed. But the job-shop man will appreciate the uses to which these tools may be put.

By the way, the job-shop machinist is continually getting peculiar jobs for which he sometimes does not have at hand the very best tools needed, so I show the ways I have at various times obtained the size of bored holes having a shoulder as shown at Figs. 4 and 5. The best way of course is with inside transfer calipers, but in the absence of these a pair of the old "double enders" shown in Fig. 4 will answer nearly as well, the points *A A* being a pair of inside calipers set to touch the outside points of the "double enders" when the inside points of same are in contact with the bore of the work. The "double enders" may be closed up and withdrawn from the hole and then reset to size with the aid of the inside calipers *A A*.

In Fig. 5 I show how the same results were obtained by the use of two pairs of outside calipers.

JEREMIAH.

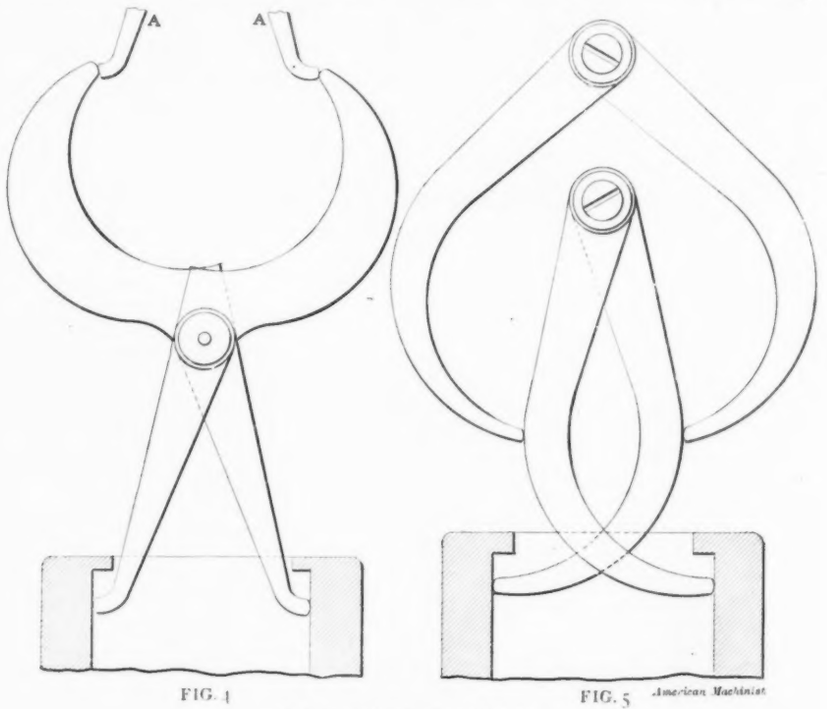

FIG. 4 FIG. 5

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CALIPERING RECESSED HOLES.

More "Points for Patternmakers"

Editor American Machinist:

Don't, in these days of Starrett and Brown & Sharpe small tools, fritter away your time making them. You can't compete either in price or quality. If you have spare time, get the AMERICAN MACHINIST or some other good trade paper and learn more about how to make yourself more valuable to your employer. When you are of more value to him you are of more value to yourself.

Did Mr. Richardson (see page 153) ever set his bevel at any desired angle by placing the blade of the bevel in his protractor where the regular square blade fits? *There* is any angle, and it can be used on both sides of a piece, which isn't possible with the protractor itself.

Let me also suggest to Mr. R. that lampblack mixed with common lubricating oil makes a paste that beats either chalk or rouge for fitting work; the ingredients are in every pattern shop.

Sawing hollow staves by running the piece diagonally across the buzz saw seems to be a good subject to write about and "con" the editor out of a few of his hard-earned dollars, but for economy in doing work it isn't worth shucks. First, because it is very hard on the saw; second, because it is not as fast as a wabble saw and a series of straight cuts worked in connection with a tilting table; and third, because the noise resembles that of a boiler shop. I do not think that the advantage of any

shop operation can possibly be demonstrated in *any* trade paper; the shop is the place for demonstrations.

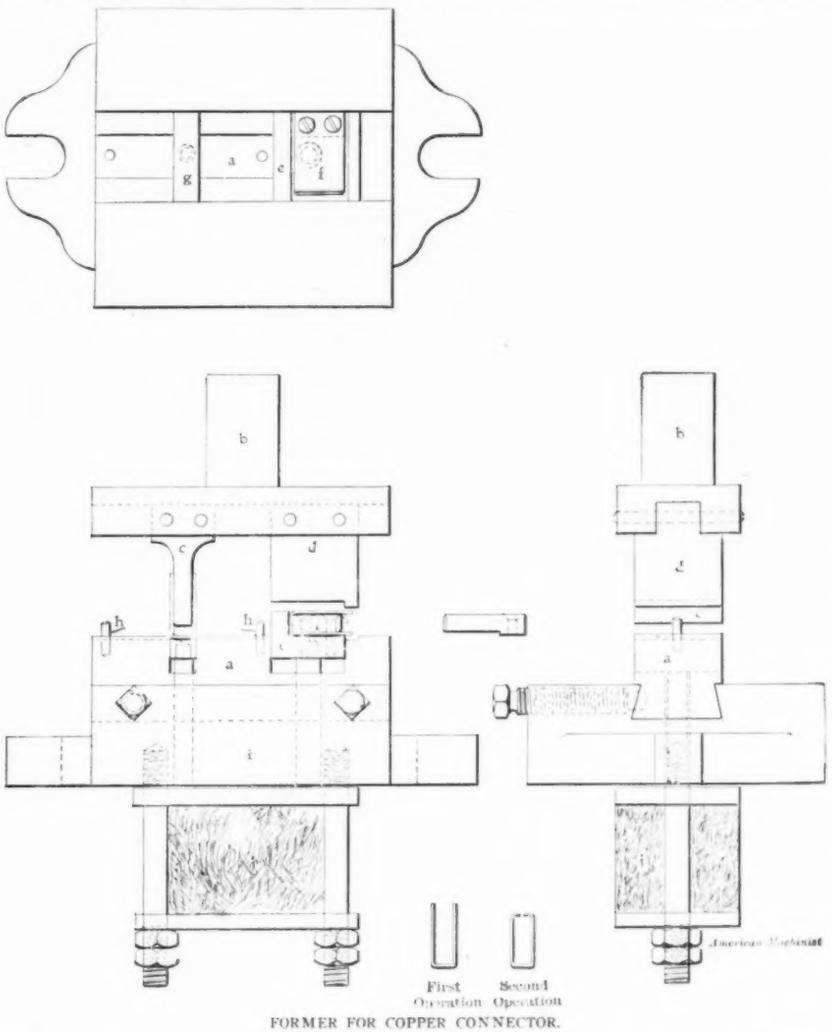
I should very much like to see Mr. Newton (see page 161) concave a stave by passing it over the saw at right angles to the saw. I should bestow upon him a full measure of praise for this difficult feat.

On looking at the angle at which Rex (page 163) grinds his turning tools, I wondered if he used them on wood or metal and also wondered if he believed in *cutting* tools. I thought of the saying, "You can't take a thin shaving with a dull tool." Neither can you take a thick one without unnecessary effort or using more power than should be required. J. L. GARD.

Former for Copper Connectors for Commutator Bars.

Editor American Machinist:

The accompanying sketch will serve to show a former used for making copper connectors which are of No. 14 Brown & Sharpe gage (.064 thick) soft sheet copper.



FORMER FOR COPPER CONNECTOR.

The metal is cut into strips 7/8 inch wide, then sheared to the proper length after which the pieces are placed in the former for the first operation.

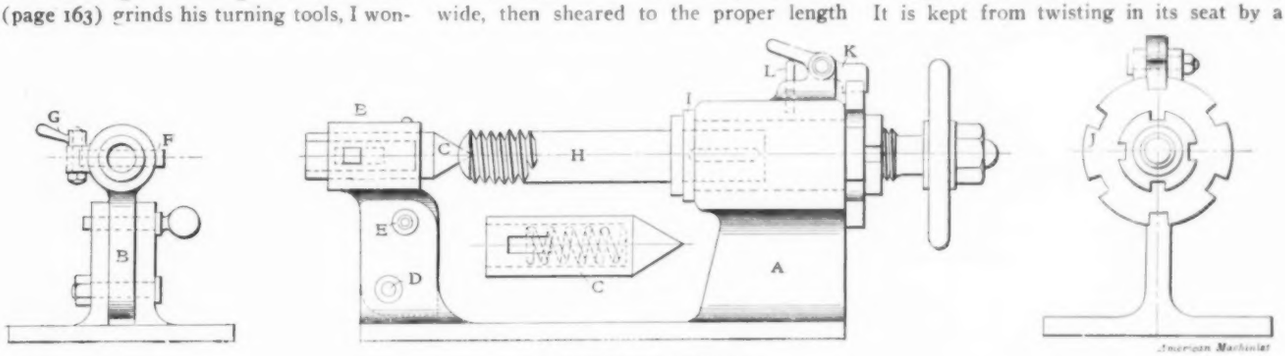
The first operation is performed thus: The blank is placed on *a* between the two guide pins *h* when punch *c* will force it down into *a*. Piece *g*, which rests on a bottom plate directly over the rubber *j*, forces the copper out of *a* as the punch is withdrawn. The partly finished connector is then slipped over *f*, which is supported on piece *e*, and as it is pressed into *a* the two ends are closed and the connector is completed.

It will be noticed that pieces *e* and *g* rest on the same plate and rubber block. This has been found to work very satisfactorily, bringing the pieces up promptly. All parts except the shoe *i* and punch holder *b* are of tool steel and are hardened. YANKEE.

A Nut Milling Attachment.

Editor American Machinist:

The attachment illustrated in the accompanying sketches is intended for use on the shaping or the plain milling machine and was designed for machining the hexagon sockets and nuts used in coupling up the rods for operating the valve gear on Corliss engine cylinders. Of course work with any number of flats can be operated upon, provided the indexing or dividing plate has the requisite number of notches for engaging the spring catch. The main casting *A* is planed on the bottom for bolting to the machine table, and consists of a base-plate with a head at the front end for carrying the work spindle and dividing plate and two lugs at the opposite end for carrying the swinging socket *B* with its center *C*. The lower part of *B* is made a good fit between the two lugs and is pivoted on the lower pin *D*, the upper pin *E* keeping it in position and dead central with the front head—both being bored out in position. The loose sliding center *C* is bored out, as shown in the detail, to receive a spring which is kept in position by a square pin *F* driven tight through *B*, a slot cut in *C* allowing the latter to slide backward and forward as *B* is swung up or down. The spring always forces the center tight up to its work; the center is locked by the small handle *G* shown in the end elevation. *H* is the mandrel on which the work is slipped and which fits into spindle *I*. It is kept from twisting in its seat by a feather. *J* is a dividing plate which screws on the reduced end of *I*, where it is held by a lock-nut. *K* is the spring catch for holding the index plate, and *L* is a pin with a spring under it for keeping *K* tight in the notches in the plate. The handwheel is for turning the work around



NUT MILLING FIXTURE.

after it has been operated on, it not being necessary to stop the machine to do this. The fixture works very satisfactorily and is very suitable for work which does not require a very high degree of accuracy.

England. W. D.

A Small Modern Shop.

Editor American Machinist:

The enclosed sketch and photograph show a building which I designed and built some time ago and which I think may be of interest to some of your readers.

The building cannot make any pretense to beauty, but it has a number of features which will appeal to the practical man more than the outside appearance, among them being very cheap first cost, perfect light and a solid floor on which machines of any ordinary weight can be placed anywhere without reference to foundations or to light.

We first spread about 6 inches of cinders evenly over our lot, settled them with water and then tamped them thoroughly. Over this we laid 6 inches of concrete, using cinders in place of sand and gravel. In this were bedded dovetail floor stringers 2 feet apart, the tops flush with the top of the concrete. The surface of this concrete was leveled north and south, but pitched to the east with a fall of 1 inch in 10 feet. We put a retaining wall around under our outer walls of concrete which we ran down 18 inches deep, but we do not now consider that this was necessary.

The unit of this building is 8 feet by 8 feet 6 inches, as long as could be made, using timber 20 feet long for roof rafters so as to cut without waste. The posts at the south eaves are 4x6 inches, 14 feet long, and all other posts 4x6 inches, 20 feet long. These posts were set on the floor and nailed in place and the rafters and braces were put on as shown. The rafters were notched into the posts 2¼ inches, as shown, the 1x14-inch board on edge allowing the swinging window to lap over same and the face of the window to come flush with the face of the posts. The windows are hung at the top to a 2x4 strip spiked along the face of posts. There are two windows in each space and short studding reaches from the roof to the gutter between the windows. This short studding is sized so as to just fill the space between the windows, and window stops are nailed up and down to the studding and the posts, so that no casing is needed around the windows, and any rain beating against them drops directly into the gutter. We swing only one window in four, the others being set solid.

As stated before, these posts are set 8 feet apart and the rafters are also set 8 feet apart, the roof being made of 2x8-inch dressed and matched plank laid dressed side down, which has been found amply heavy. The roof is covered with tar felt, 5-ply on the roof and 7-ply in the gutters, and covered with gravel. We have had no trouble so far with gutters or with any sweating of the under side of the roof.

The walls are of drop siding, and we have put 2x6-inch studding between posts. The walls are lined up first with tar paper which is held on with battens on top of which we lined with "compo" board which

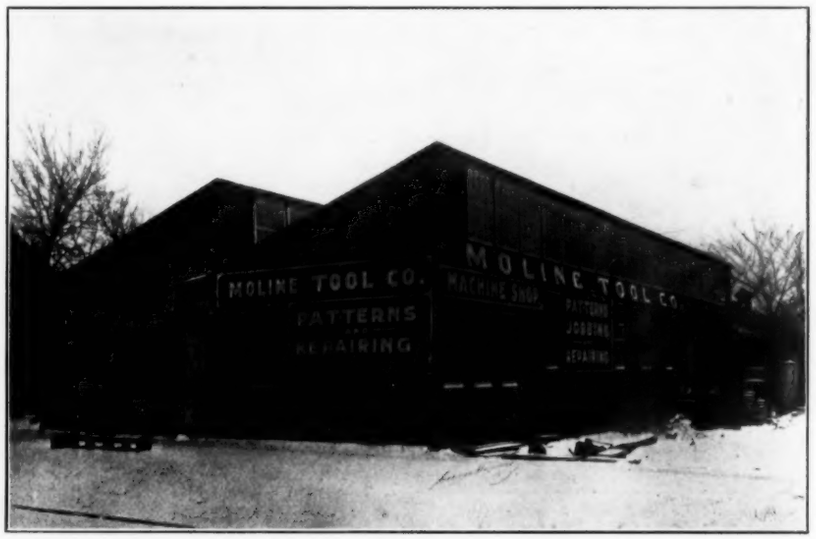


FIG. 1. A LOW COST SAW-TOOTH ROOF SHOP.

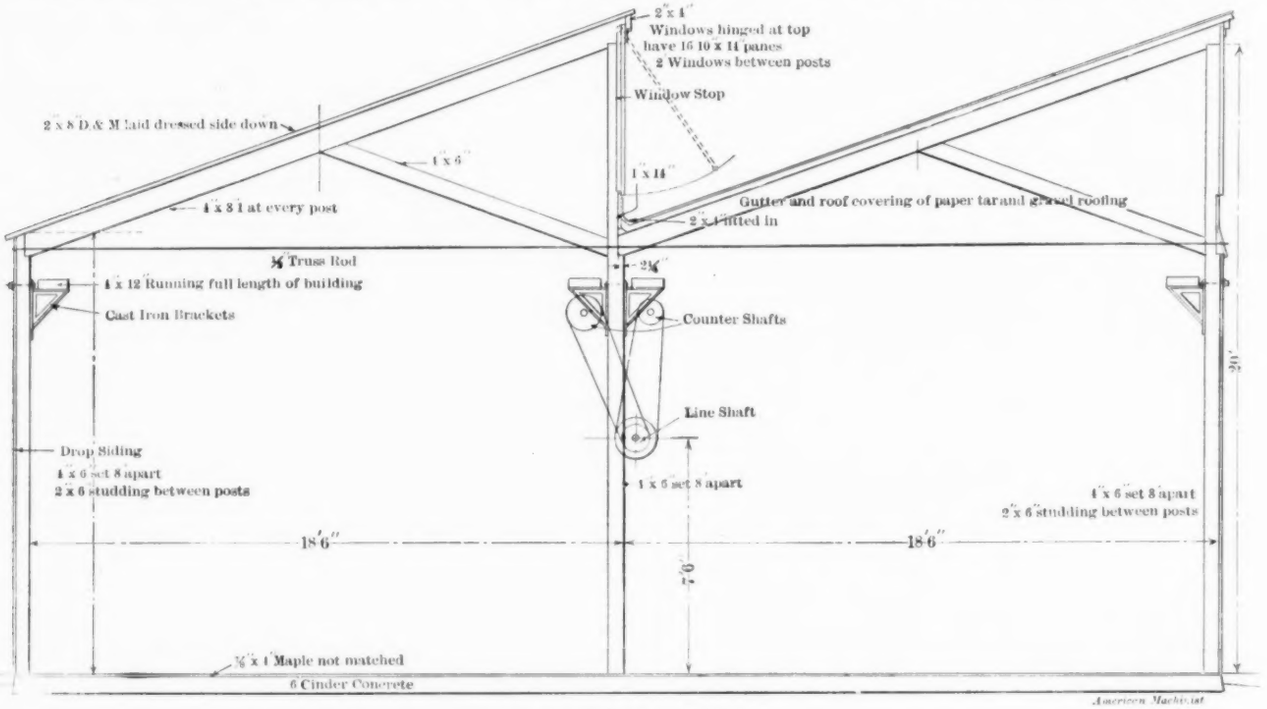

2" x 4"
Windows hinged at top
have 16 10 x 14 panes
2 Windows between posts
Window Stop
2 x 8 D.& M laid dressed side down
1 x 6
1 x 14"
4 x 8 1 at every post
Gutter and roof covering of paper tar and gravel roofing
2 x 4 fitted in
¾ Truss Rod
2¼"
4 x 12 Running full length of building
Cast Iron Brackets
Counter Shafts
Line Shaft
Drop Siding
4 x 6 set 8 apart
2 x 6 studding between posts
1 x 6 set 8 apart
4 x 6 set 8 apart
2 x 6 studding between posts
18'6"
18'6"
20'
⅛ x 4 Maple not matched
6 Cinder Concrete
American Machinist

FIG. 2. DETAILS OF SHOP.

leaves an air space and makes a very warm building. The 4x6-inch braces of the roof rafters are merely spiked in place, with a ½-inch truss rod to every section of the building.

We bolted cast-iron brackets on the posts, on which are 4x12-inch planks running the whole length of the building, as shown. These planks serve several useful purposes. They stiffen the building sideways, make a convenient path to walk along when cleaning the roof windows, form a track on which may be run a light traveling crane the whole length of the building, and last but not least form a very convenient hanging for the countershaft. We placed our line shaft in Hyatt bracket roller bearings hung on the side of the central row of posts 7 feet 6 inches from the floor and we arranged most of our machines in rows in the center of the building, using the sides of the building for bench room, erecting floor, etc. At the ends of the building where we do not care for the crane to run we have placed machines along the walls, belting from the line shaft to the counters hung on the planks along the rows of posts. If desired, of course, line shafts can be run along each row of posts.

We use electric group drive, and plan as we extend our building, to have a line shaft with independent motor drive along each row of posts, so that any group of tools may be run independently of any other.

As will be seen from the sketch, this building can be put up with a minimum of skilled labor and with practically no waste of material. There is no waste room on the floor and the walls and ceiling of the building present only broad, flat surfaces which can be easily gotten at to clean and paint, and there are practically no dark spaces for the collection of dirt and dust. The belting, countershafting and line shafting are grouped so as not to obstruct the light and spread dust and grease all over the shop.

As with all saw-tooth roofed buildings, this one can be increased indefinitely without interfering with the light or making it appear as a patched-up building.

We believe that this is well worthy of consideration of any who are planning to build and are anxious to get the maximum amount of solid, well-lighted shop floor at a minimum cost, and have minimum expense for repairs and insurance.

I know of at least one factory which has exactly duplicated this building, only on a very much larger scale.

WILSON P. HUNT.

Two Screw Machine Fixtures.

Editor American Machinist:

The fixtures here shown are designed to be mounted on a screw-machine face-plate. The fixture in Fig. 1 is for hollow milling the part *a* of the casting Fig. 2, and also for drilling and tapping the center hole, the hole *b* being previously drilled and reamed in a jig. In the fixture the clamp *c* swings down and allows *d*, which is provided with a small pin to bear against the center of the work to swing out. Plug *e* has a flat milled on the under side at the outer end and *d* just swings under, taking the thrust at that end of the plug.

The advantage of the rocking clamps *f* over set-screws is that the bearing points are at the greatest possible distance from the center of *e*.

The fixture Fig. 3 is for hollow milling and threading the shank *g* of the brass

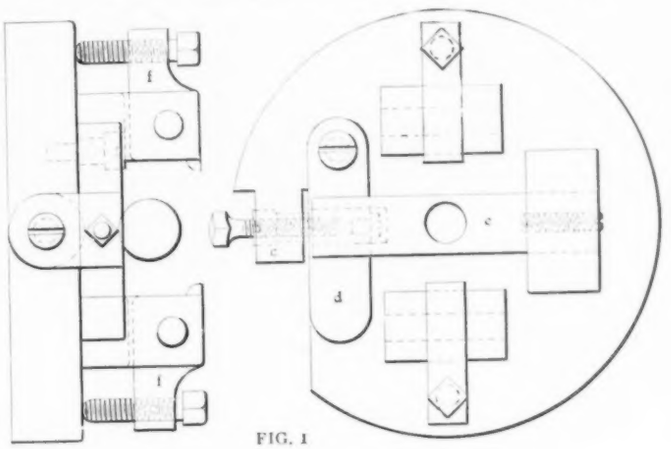


FIG. 1

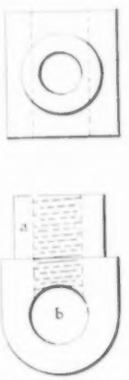


FIG. 2

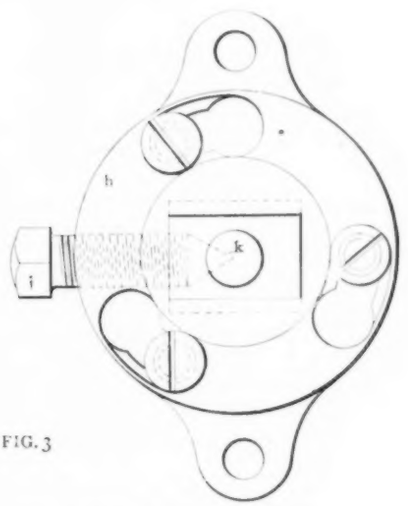


FIG. 3

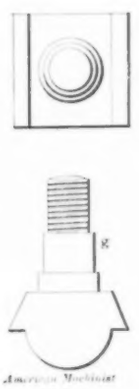


FIG. 4

TWO SCREW MACHINE FIXTURES.

casting shown in Fig. 4. In this fixture *h* is a machine-steel plate knurled on the outside and having a rectangular opening to hold the body of the work. By giving this plate a slight turn backward it can be removed from the body *i* of the fixture, the method of attaching the plate to the body being clearly shown.

The work is inserted in the plate and the screw *j*, having a conical end, forces the pin *k* against the back of the work, holding it securely against the angular sides of the pocket in the plate.

W. E. WILBER.

Repairing Cracked Gas Engine Water Jackets.

Editor American Machinist:

Having had, this winter, to repair several gas-engine water jackets that had been cracked by the freezing of the water in them, I thought a description of my method might be of interest to your readers.

I first chipped a dovetailed groove, following the crack, about half the thickness of the jacket in depth by ¼ inch width at the top and 5-16 inch at the bottom. I then ran the groove full of solder, peening it in carefully and smoothing it off and got a very good job.

I have watched for several months a number of engines that I have repaired in this way, and the indications are that the job is permanent and satisfactory in every way and much cheaper than a new cylinder. As an experiment I filled one groove with a cast-iron cement called "Smooth-On" and, while it has held so far, I think that in time it will crumble from the vibrations and begin to leak again, but it offers another way out of a difficulty if one does not happen to have the facilities for soldering at hand.

BUCK.

Making Chuck Jaws.

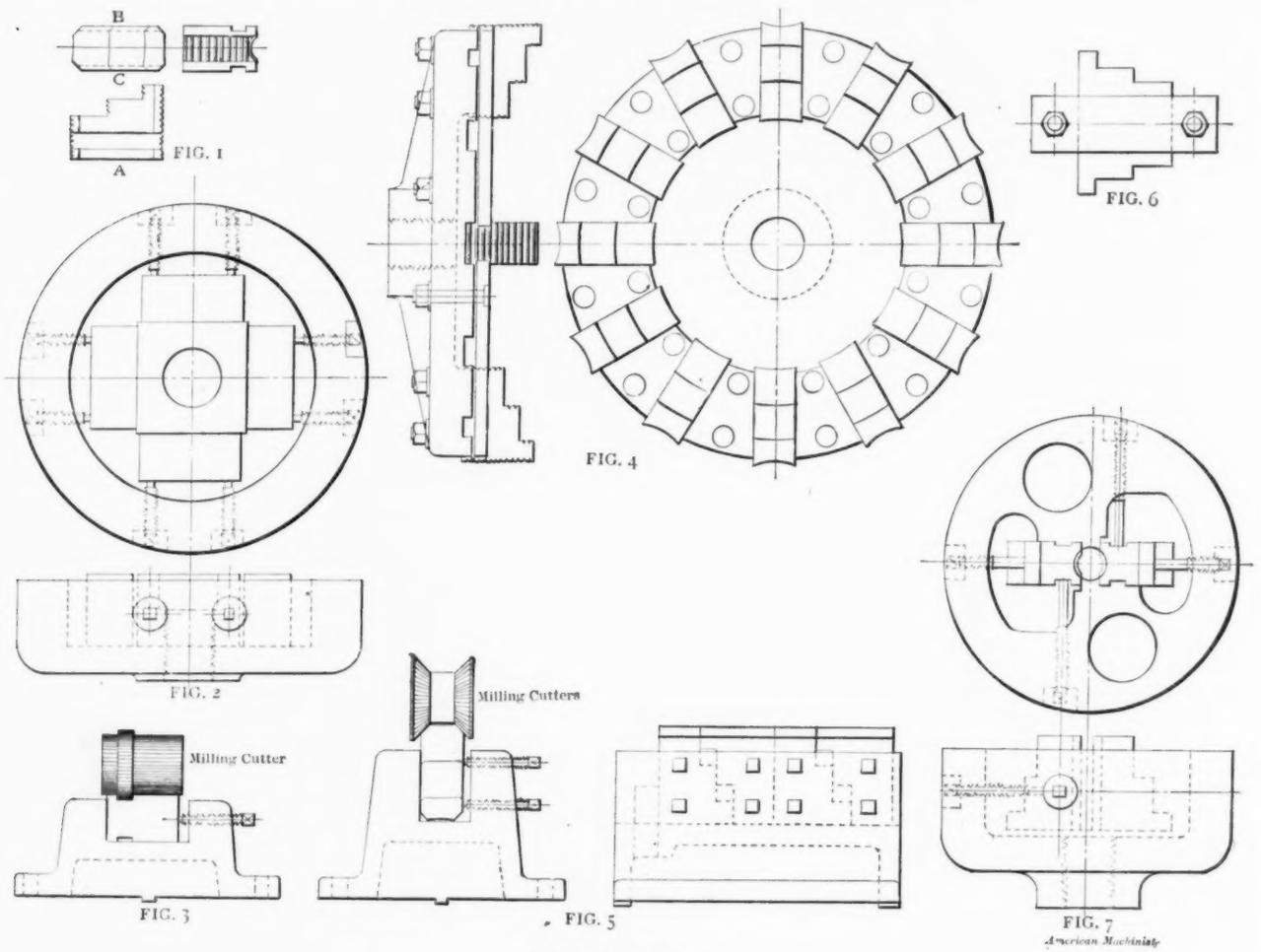
Editor American Machinist:

The chuck jaw is a part of the lathe which gets very little attention when it holds the job firmly. If it fails, it handicaps the lathe to a very great extent. It is surprising, when looking through chuck makers' catalogs, to see the number of different shapes the chuck jaw assumes. As we manufacture from 1,200 to 1,500 jaws annually, we have had to go into the making of them systematically. Fig. 1 shows our standard chuck jaw, the underside being threaded. Our method of making them, which gives excellent results, is as follows:

Rolled bars are cut off in the metal saw, 1-16 inch for machining being allowed all over. We tried forged steel, but were troubled with marks in it, caused through the steel being hammered when too cold. First we machine the side *A* in a lathe, the jaws being held in the fixture shown in Fig. 2, which screws on to the lathe spindle, and allows us to machine four at a time. Some machinists would advise doing this job on a miller; we tried both ways and were surprised at the time that was saved when doing it in the lathe. Fig. 3 is a fixture for holding the jaws, four in number, while milling the sides *B* and *C* and the groove in each side. A number are milled on one side, then the table is raised and the same number finished on the other side to gage. The fixture Fig. 4 screws on to the spindle of a lathe and holds twelve jaws while the steps are formed and the serrations cut in the gripping surfaces. Each jaw fits in a groove and is held by two plates, and each plate is tightened by two bolts. Care was taken, when making the fixture, to get the grooves all the same depth to a thousandth of an inch. Both ends of the jaws are beveled to permit of their holding a job which is small in diameter. Fig. 5 shows the fixture for holding them while being machined with two angular milling cutters, the length of the bevel being determined by the collar between the cutters. After the jaws are touched up by hand, and the sharp corners taken off, each jaw is put into a clamp shown in Fig. 6, ready to go into the hardening furnace. Before putting them in, the surfaces not to be hardened are covered with molder's clay. The clamp is of heavy design, as trouble was experienced at first with the jaws twisting.

The last operation before putting the jaws into the stores is the threading, which is done in the fixture, Fig. 7, where they are handled in pairs in a lathe. We used to perform that operation before hardening; but what with the jaw twisting and the pitch of the screw altering, we had to change this method, keep the side *A* soft and form the threads after the jaws came from the furnace. L. E. W.

Johnstone, Scotland.



CHUCK-JAW TOOLS.

Roasts in Machine Shops.

Editor American Machinist:

"Of all the good-for-nothing, brainless idiots I ever saw you are the worst. You —— —— ——. Get out of this before I kick you out, and don't ever come around again looking for a job. You ought to be shoveling dirt in the street."

Burnt to a crisp, and nothing left of any use to anyone, but the house filled with a horrid odor.

"You will have to wake up somehow, and tend to you work better. I can't afford to be standing over you all the time. (Had to go after him three times in two months about finishing details.) The big end of your work has to be gone over in some way to have it just right. (Eight pieces out of a total of several hundred.) I am tired of being chased by the office from morning till night on account of the —— shiftless work that is being done, and I'm going to fire every man that does it after this. I'm going to stop it."

Scorched badly, but may be of some use if carefully trimmed.

"Here is a job that has been very poorly done, and I find that you did it. We cannot afford to send out such work, and you cannot afford to do it. We could not keep a man that did much of such work. This is the first time that I have had to come to you about such a matter, and as it is disagreeable to both of us I hope it will not be necessary again."

There are very few varieties that will not be well done after that.

"I was very much surprised to find any work coming from your hands that was not first class in every way. I am sure that all I need to do in this case is to call your attention to it, and it will never happen again."

This is only suited for the choice, high-grade varieties, but where a proper selection of material has been made in the marketing the results will suit the taste of the most fastidious.

"Please fix this up a little before it goes out, and say, don't you think you could pay a little more attention to your work? I am sorry to bother you about such things, and would not do so if I could avoid it?"

Only good for cuts that are best relished quite rare; for regular conditions it would be much underdone.

"I know that there is lots of this work that should be done better, and the men know it, too. There isn't any use saying anything, though. I try to get good men, and they start in good enough, most of them, but they don't stay good. One seems to get about so much bad work from each of them on an average. The only difference is that one gives you one kind of bad, and another one gives another kind."

Raw, and not to be recommended for a regular diet, although there are times, especially when a cook has just gone to a new place, where it has a useful place for a short time.

To those who have this work to do I would say: no two lots of material are exactly alike, and each lot has to be studied and treated by itself. By keeping in mind to watch results carefully, the work will be made easier, and fuel will not be wasted by applying heat where it does no good, and perhaps does much harm. It is well to bear in mind that it is easier to make use of an underdone article than of an overdone one. Avoid scorching the outside while leaving the inside entirely raw.

Most beginners use too large and too hot a fire, and then continue the cooking too long. WILBER.

Driving a Taper Pin in the Grinder—Turning Uncentered Work.

Editor American Machinist:

As I am a reader of your journal and often see some very valuable shop kinks in it, I hereby submit one or two which I have found quite a help at times.

Suppose a small taper pin is to be ground on centers. A dog cannot be used, as this would not allow the wheel to travel the entire distance across. Now, if a small piece of soft wire be bent something like the letter Z and one end soldered on to the end of the stud, it will allow the wheel to travel across and make a very effective dog. This can also be applied to turning, and when taking light cuts will be found to work very well.

Another little kink is of value when one has to turn or grind a piece which has no centers. In this case, solder a piece on to each end of the work, and center. When finished the soldered pieces can easily be removed. J. A. GEMMERICH.

A Home-Made Grinding Rig.

Editor American Machinist:

Having occasion to true up the inside of the hardened ring carrying the cutting edge of a bottom die, where the only available tools were a lathe and its accessories for simple repair work around a factory, I rigged a small emery wheel on the slide rest as follows:

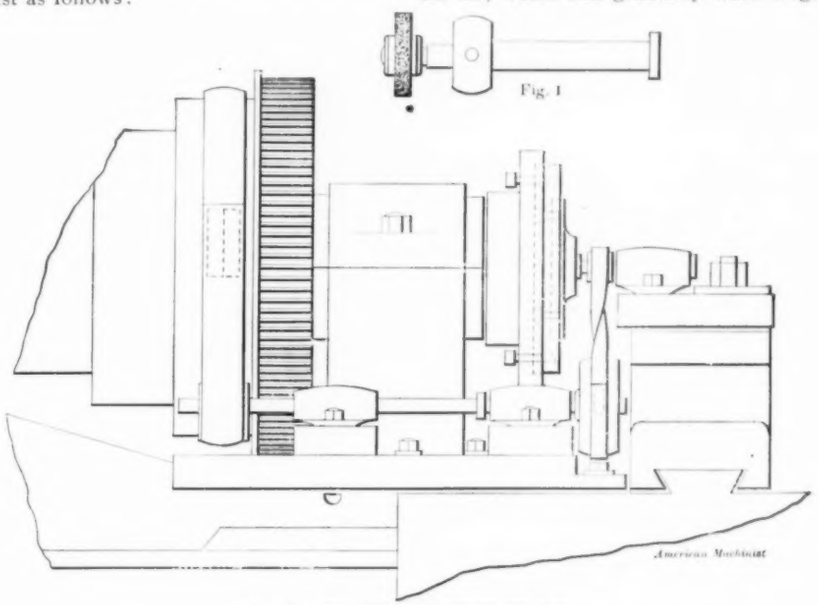


FIG. 2. HOME-MADE GRINDING RIG.

The inside diameter of the ring was about 2½ inches, which necessitated a small wheel for the work. At a sawmill nearby was secured a broken wheel out of which could be obtained the center and surrounding portion of about 2 inches diameter by punching off all around to the depth of the break. This gave a 2-inch wheel about ½ inch wide, and with a ½-inch center hole in it. Next were secured from a machine three solid boxes with ¾ inch bore. For one of these was turned up from 1-inch stock an arbor like Fig. 1. A small shoulder was left at one end of this arbor and near the other was fitted a small pulley with the face crowned considerably so as to permit of swinging the spindle somewhat. This same end was cut down to ½ inch diameter for the wheel and threaded for a short distance from the end. Then, with two collars, one to slide on before the wheel and the other to screw up against it, the mounting for the wheel was complete. The box carrying the emery-wheel spindle was bolted to a block of hardwood of the right thickness to bring it to the same elevation as the lathe centers, the block in turn being bolted to the slide rest, as shown in Fig. 2.

In a T-slot on the carriage was bolted a timber to project towards the headstock cone. This piece carried two of the boxes, the shaft running in them, and two pulleys, the boxes being blocked up sufficiently for the pulleys to clear the wood. One pulley was alined with the largest step of the cone, the other with that on the emery-wheel spindle. A small piece of wood inserted between the lathe and the overhanging block steadied the free end of the latter.

The line shafting ran faster than that of a machine shop ordinarily, and gave the wheel speed enough to cut fairly well. With the wheel once running it was an easy matter to straighten up the hole in the die, which had gradually worn larger at the outer end so that the punch bound at the lowest part of its stroke, the die being sharpened generally by grinding back the shearing edges. To give the wheel motion opposite that of the work, it was necessary to use a cross belt as shown, unless a friction drive were used from the cone pulley in place of the belt. This was only necessary on inside work; and in grinding the centers, which was afterward done while the attachment was on, a straight belt was use'. The die was rotated by the back gearing; the centers were rotated direct.

The die was screwed on to a blank which was recessed at the center and drilled and counterbored for the die screw, the same as the regular cast-iron bolster. This blank was in turn secured with cap-screw in a recess in a chuck which a larger size of die could occupy if it was necessary to work on it. I. F. A.

Making Piston Rings.

Editor American Machinist:

I enclose sketches of tools for use in making piston rings. Fig. 1 shows a tool-holder which is fastened to the slide-rest with two bolts and has a tongue on the bottom to hold it well in place. The sleeve casting is fastened to the face-plate of the lathe with four bolts. Rough turning and boring are done at the same operation, after which a finish cut can be taken with the same tools. The tool-holder should be of heavy stock—about 1½ inches square and about 4 inches wide over all. Fig. 2 shows the tool-holder for cutting off the rings. It has a tongue on the bottom and is fastened the same as the other tool bar. The cutting-off tools can be wedged or fitted in and must be the same distance apart and should be arranged in steps, as shown. Place a bar between the lathe centers to keep the work steady and the rings will drop off one at a time and be caught on the bar.

J. H.

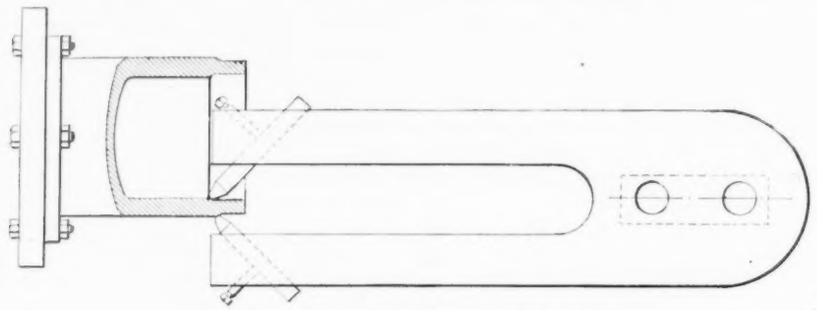


FIG. 1. TURNING AND BORING TOOL-HOLDER.

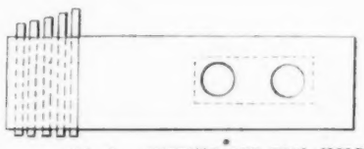


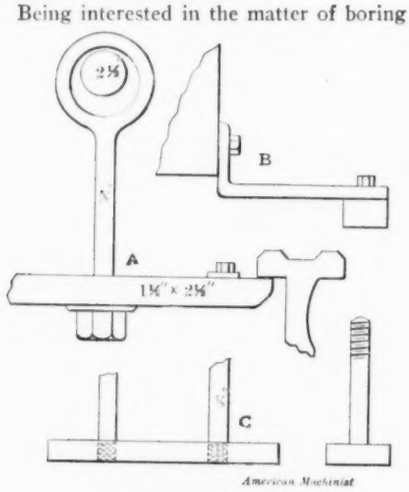
FIG. 2. CUTTING OFF TOOL-HOLDER.

Staying the Boring Tool.

Editor American Machinist:

Being interested in the matter of boring tools and noting M. H. Ball's description at page 150 of an appliance for holding a straight bar, I would like to ask if in the matter of stress and strength it would not be better to put the strain of the cut on the bed of the lathe instead of on the carriage. I use a similar tool, but have a cross-bar riding under the bed of the lathe, as in the sketch at *A*. The cross-bar is held in position by two straps attached to the side of the carriage as at *B*. This takes all the twisting strain off the carriage. Also why not use a solid plate with studs screwed into it as at *C*, instead of loose bolts? Then he can slip the head into tool rest without feeling around to get the bolts straight.

W. H. BOARDMAN.



STAYING THE BORING TOOL.

The "Old Way of Making Machinists" Still Survives.

Editor American Machinist:

At page 297 you quote from an article in *Fibre and Fabric* on "the old way of making machinists," and you might truthfully have added, "the present way of making master mechanics" in many manufacturing plants in this country, particularly textile plants similar to that where Mr. Holmes gained his experience.

No doubt many of your readers will regard your quotation as being printed as a satire, rather than as a plain statement of facts. Of course, they might very reasonably have doubts about that pulley yarn. In the light of my own experience, any man that could turn up 150 pieces of work of any kind and get them all "perfect" the first week in the shop would be a freak well worth the attention of museum men. A turret lathe with a competent toolmaker to secure adjustments might accomplish much more than that, but neither toolmakers nor turrets are much in vogue in textile repair shops even to-day. The general substance of the piece, however, is very much to the point, and the following incidents which have occurred in recent years bear out the statement that mechanics are still being manufactured by the same old method.

About five years ago, wishing to secure another apprentice for my own shop, I employed a young man about twenty years old, brought up on a farm, having steady habits and a fair amount of intelligence, and put him at work, paying him 75 cents per day and promising a raise as soon as he was worth it to the shop. I didn't put him running a lathe the first week (and this, no doubt, was where I made a fatal mistake) but, remembering my own early trials, I gave him such work as I thought it would take too much trouble to spoil.

In less than a week he began to show signs of inventive genius. First it was a 2-inch square piece of broken looking glass set at the proper angle on the wall in front of his vise, so that he could tell when the shop door began to open and always be busy at the proper time. Next he needed a seat that could be readily adjusted to his needs while he filed cast gear teeth or tapped nuts and other work with the hand taps, and he made it, or at least he was sitting on it one day when I came back from a forenoon at the foundry. Oh, yes, he was ingenious, but that didn't turn out the work, so he had to go.

Within a year from that time I chanced to be in a neighboring town, and while there I visited some of the cotton mills, and in one I found my former apprentice, an apprentice no longer, but a "master mechanic" with two men at work for him. While I was there he showed me a letter from another mill about twenty miles away asking him to come up to see them, as they desired to make a change in the head of their mechanical department.

At another plant the master mechanic resigned his position to accept a more flattering proposition and the manager decided he would make this his opportunity to reduce expenses, therefore to replace the $1,800 man that left he promoted one of his carpenters to the master mechanic's position, paying him $3.50 per day. His duties included the care of the power plant, which was a large one, as well as looking after the repairs and supplies, elevator men, watchmen, etc. To illustrate his entire lack of machine-shop knowledge, one day an under foreman from one of the rooms came to his office with a small gray-iron roll, perhaps 4 inches long by 1 inch in diameter, with journals about ⅝ inch in diameter, one of which was broken off. The foreman said he would want forty or fifty of them, and the master mechanic, as the foreman went out, called him back to ask him if it was necessary to have those holes in the ends drilled exactly in the center (meaning the center holes on which they were turned).

That man, however, has realized that opportunity has knocked on his door in passing and he is improving himself as fast as possible and will no doubt soon be worthy of a much better salary. Whether he will ever get it at that plant is a matter for conjecture, as it is probable that a manager who has once been willing to keep payroll costs down by carrying the experience costs of an apprentice master

mechanic will do so again, the costs in the latter case being vague, indefinite memories, while the payroll cost has a mighty bad habit of looking a man in the eye every week.

It is common practice in the South to recruit the machine repair shops of the mills from the class of loom fixers who have proven their inability to fix looms, but who have acquired a lot of hammers, wrenches, chisels, etc., in connection with their desire to become machinists; they generally begin at about 75 cents to $1.00 per day, and it is uncommon to find one of these graduates making over $1.50 per day in a mill shop.

I recently induced several of these repair men to subscribe for the AMERICAN MACHINIST, and while the more advanced ones expressed their satisfaction with the paper, one of the more recent acquisitions said "he didn't know he was buying a dad-blamed catalog when he gave me his subscription."

There is generally one man in every textile machine repair shop who has served his apprenticeship in the regulation shop and in the regular three or four year way, and this man, while nominally foreman of the machine department, is a "straw boss" under the thumb of the master mechanic, but he furnishes the "know how" for the entire shop.

It is to be remembered that the master mechanic is often limited by the superintendent as to the number of men employed and the wages paid them, and still oftener he has to make out with a number of old men who are really of little use to him, because these men have large families that work in other parts of the mill, therefore they must be kept employed in order not to lose the rest of the family.

Verily, the life of a master mechanic is not all sunshine, no matter what process was used in his production.

West Point, Ga. L. L. ARNOLD.

A Boring Fixture and Outfit.

Editor American Machinist:

The illustration shows various views of a tool and boring bar fixture and its equipment. The fixture, Fig. 1 is secured to the tool-post slot by tightening the square-headed bolt *a* by means of a socket wrench. The cap *b* swings to open and close by means of double-acting hinge links of cold rolled steel. These hinges are pinned by cold rolled rods of ample size extending through the entire length of fixture. Bars, tool-holders, drill-holders, etc., are clamped in the fixture by means of a hinged, double-threaded bolt *c* having a lead of ½ inch. The threaded lever *d* binds or releases the cap by a quarter turn and permits quick changing of bars and tools.

In making the fixture, all planing, including that of the tongue for the tool-post slot, which should be a snug fit, should be completed; the hinge links and clamping bolt should be assembled, the fixture be strapped in the tool-post slot in proper position, and the hole for the bars be drilled and bored with an ordinary boring bar in the center of the lathe. A line should then be scratched on the carriage for future reference in locating the fixture central with the work. Clearance should be planed from each half of fixture in order to allow the halves to bind upon the tool bars.

A novel feature in connection with boring true holes, when using this or any other fixture of its type, is the loose double-ended cutter. The hole is first bored with a single-pointed boring tool, leaving 1-32 or 1-64 inch for finish, when a loose or floating double-ended cutter, Fig. 2, ground to size is placed horizontally in the slot *b*, which is larger in width and thickness than the loose cutter, thus allowing freedom of movement in all directions, and the tool is run through the hole previously rough bored. It will readily be seen that, while in boring the hole with a single-pointed tool, the lathe may bore tapering, nevertheless the hole will be trued axially, and if the loose or floating cutter is run through the hole and if the material is of homogeneous structure, the result will be a straight hole of unvarying diameter, a result oftentimes hard to obtain rapidly by ordinary methods. The sketch also illustrates, in Fig. 3, a twist drill holder, in Fig. 4 a sample bushing for various size bars, and in Fig. 5 a tool-holder for various tools, made from ¾ inch air-hardening steel. C. B. C.

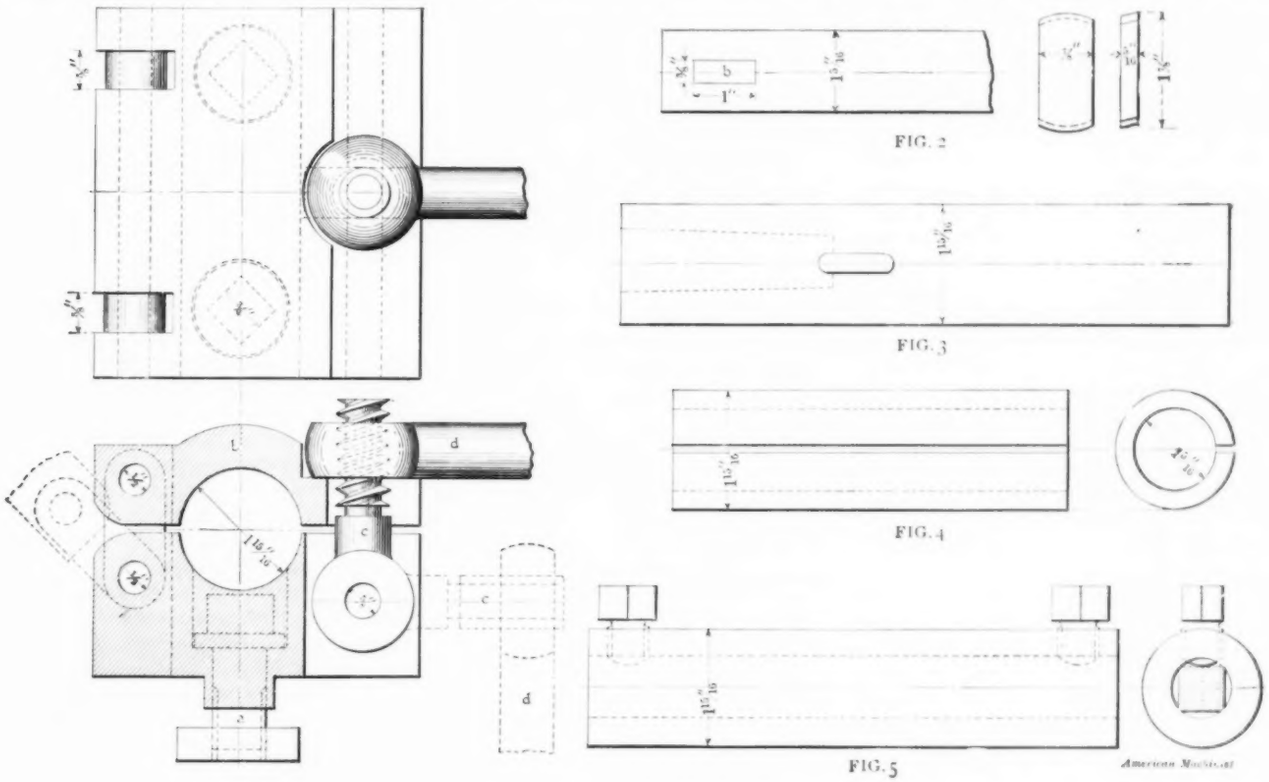


FIG. 1

FIG. 2

FIG. 3

FIG. 4

FIG. 5

BORING-BAR FIXTURE AND TOOLS.

A Movable Index for the Micrometer.

Editor American Machinist:

The movable index for the micrometer shown in the sketch will be found very

handy when removing small quantities of metal from several similar pieces, as in grinding and lapping operations, and also for transferring measurements containing fractions of thousandths. When the dimension is in exact thousandths the index may be pushed back clear of the divisions, simply pointing to the one required. When used to indicate fractions of thousandths it may be brought to the edge of the thimble, forming a temporary division. It is made of spring steel, blued for distinctness, as shown at *A*. If made in this shape, it may be sprung tightly on the thimble and yet be easily moved by pressing on the turned-up ends in the direction to open the spring. A. R. R.

Boston, Mass.

Loom Manufacture as Seen by a Machinist.

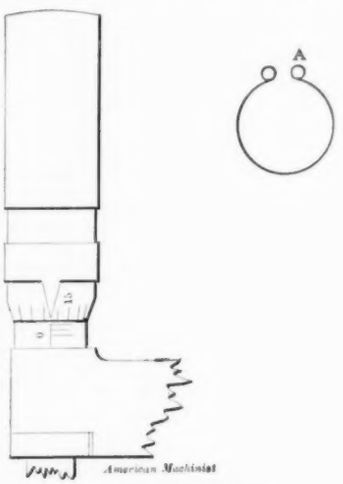
Editor American Machinist:

Some years ago I became connected for a time with one of those curious institutions known as "loom works." You see, I was young and anxious to broaden my experience in different lines of mechanical work; so one day, after giving due notice, I "jacked up" my job and turned my steps loom-ward. At the shop I was leaving they had a way of finishing up everything bright and true, and although I had a vague sort of a notion that this wouldn't do in my new field of labor, I was hardly prepared for what followed. At the end of six months I did not entertain a single doubt that I had obtained a generous measure of experience. It seems necessary to state at the outset that the establishment which I went to compared very favorably among those of its kind, and its machines ranked high in the textile world.

In my position there I came more or less into contact with all the departments in the shop. At first I was badly handicapped by a tangle of unfamiliar names for machine parts, and for a week or more I dreamed of breast-beams, lays, pickersticks, swords, daggers, cops, dobbies and a hundred others. By the time these were straightened out I had also learned that this shop seemed to have two fundamental axioms in turning out work—first: "Make it adjustable"; second, "That's near enough," the former holding sway in the drafting room, the latter in the rest of the shop.

An examination of the drawings one day proved of interest. Finish marks were most conspicuously absent; bronze bushings, or even babbitt for bearings, seemed unknown; gears, large or small, had cast teeth and many working parts of the loom were of wood. Shafts were universally of cold rolled steel, except the driving crank shaft. This was about 6 feet long, and was made roughly of wrought iron and had two wooden connecting links carrying loops of wrought iron around their ends for a bearing at the cranks. As before hinted, all parts were made adjustable wherever possible, this being usually accomplished by providing long slots for holding-down bolts. Instead of spending good dollars in the machine shop for true surfaces, "chippers" were provided on bearing faces; *i. e.*, the iron stood about ⅛ inch higher along the edges of the face than in the middle. If the piece didn't go into place properly (and it never did) there was a little touching up with the file along these narrow strips, and a "near-enough" fit resulted. Gears that didn't mesh properly had their bearing bolts loosened, the bearings were then given a knock or two, and there you were.

Out in the machine shop long rows of drill presses were under the control of young boys. These machines seemed to have a corner on the market here, for it was with difficulty that I discovered a lathe or two, a shaper and a milling machine. As for grinding machines or gear cutters, there were none. Even with all the drilling that was done, there were very few jigs used. Picking up a number of small castings, it at once became evident that the boys were on piece work and that quantity, not quality, was most desirable. It didn't matter how rough the hole was, nor if it came anywhere from ⅛ to 3-16 inch away from the center of its boss. Holes drilled near the ends of shafts for cotter-pins (which was the way of keeping gears, levers, etc., from sliding off) never found the shaft's center. It was an interesting collection around those drill presses.



INDEX FOR MICROMETER.

Just to give an idea of the sort of machinists employed in this shop, here's a true story about the foreman. He was quite a young man and had recently been promoted. Promotions and discharges were very frequent. Well, one day one of the men approached the new boss—who "felt his position," the boys said—with the question:

"Say, I've got an order here to make a reamer and we ain't got nuthin' to make it of. What'll I do 'bout it?"

This was the reply he received, spoken in rather a scornful tone:

"Ain't got anything to make it of? Why certainly we have; there's plenty of *cold rolled* up on the rack there."

One day I came across some curiosities in the shape of gray iron worms, about 2 inches in diameter. Owing to carelessness in molding, the threads around one-half of the circumference were about ⅛ inch ahead of the threads around the other half. The ridges thus formed, however, had been filed down and I afterward saw these worms in place in looms. It was the same way with about everything else. Even shafts that refused to enter bearings had this file treatment. It was "good enough." Sometimes, though, these crude methods were of no avail, for gray-iron parts would come warped and a piece that would fit into one machine would be a quarter of an inch out on the next. I have seen a small lever go back to the drawing-room for redesigning at least six times on this account, only to be finally discarded for some other arrangement. As such occurrences were frequent, the air in the shop was always more or less tainted with an odor as of burning brimstone.

Owing to the large number of gray-iron parts needed, the "snagging" room played an important part in the manufacture. The piece-work system was in vogue in this department also, and was supposed to keep the output on a profitable basis. Evidently it did for the snaggers, for one day a young clerk in the office discovered that they were making on an average 40 and 50 cents an hour. This discovery he promptly made known to one of the proprietors, only to receive the astonishing reply, "I don't care how much they get, if they earn it." This will serve as an illustration of the looseness of the shop's management.

Under such conditions as these, this unique establishment turned out its grist day after day, and it seemed a wonder that the finished machines took a notion to run at all. Yet they were always slap-banging away in the "weave shed" (when they weren't "knocking off") and some even had motor drives, although I could never quite decide why the motor pinion was of rawhide with epicycloidal teeth and the driven gear on the loom gray iron with involute teeth.

There was exhibited in the design of these machines much mechanical ingenuity, yet what vastly better results could have been obtained had there also been a little more skillful workmanship, a little better material and a little less green paint! Even in the strenuous competition with foreign countries it seemed to me that mill owners would some day become convinced that machines better mechanically would very soon prove dividend-paying investments.

CHIPS.

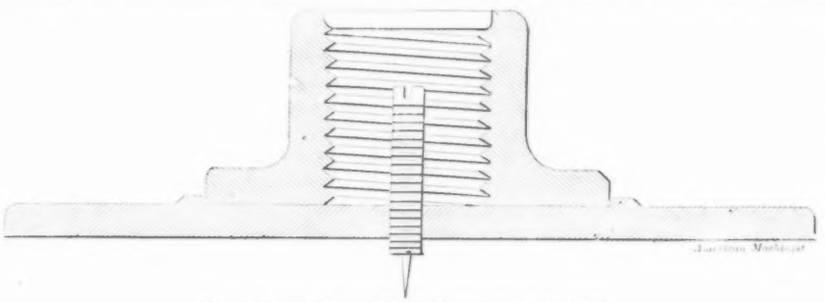
A Face Plate for Wood-Turning Lathes.

Editor American Machinist:

The accompanying sketch shows a face-plate for wood-turning lathes which I have found very useful in making patterns and

core boxes for such goods as globe and angle valves, cocks, etc. It consists of a face-plate which screws on the lathe spindle in the usual manner, with the addition of another plate fastened to the first by screws and held true by the rim on the back side which is bored to fit closely on the first plate.

The front plate is drilled and countersunk as usual, and has a long screw fitted accurately in the center, which screw is



FACE-PLATE FOR THE WOOD-TURNING LATHE.

pointed as shown, and is used in centering work on the plate. It can be screwed out some distance from the plate to center pieces from their center lines. The outer plate can also be removed and small work be centered to it much more accurately than is possible with the ordinary face-plate.

C. E. PAGE.

Bending Tubes.

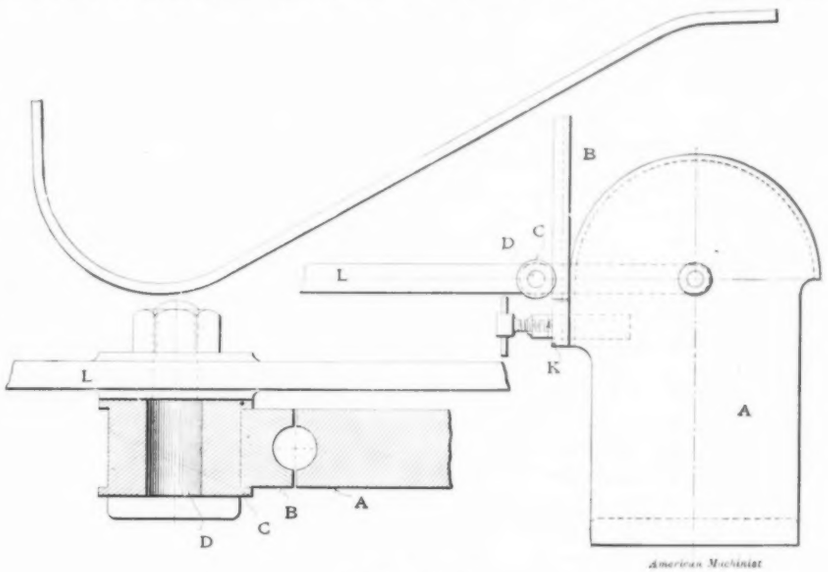
Editor American Machinist:

The bending of tubes is always a matter of more or less difficulty, which increases with the thinness of the walls of the tube and the shortness of the radius of the bend. Tubes of a heavy gage that are to be bent to a large radius are comparatively easy to bend without an excessive amount of crinkling or flattening, but with a tube whose walls are very thin, and the radius of bend short, it becomes quite a different matter.

Some time since it became my duty to rig up a fixture to bend a ½ inch outside diameter hard drawn copper tube, having a wall but .012 thick. Several methods had been tried with but poor success—the tube filled with sand, water, rosin, bent by heating the long side of the bend with a torch and finally a fixture had been made with a grooved form and a grooved roll, but all proved inefficient. As the tubes were to stand side by side in a long row and be in a very conspicuous place, uniformity of bend was essential.

Having designed several fixtures for bending tubing for automobile work, the design for the fixture was finally given to me, with the remark: "Someone said you knew how to bend tubes. Here's a job we are stuck on. We have overrun our promise of delivery, so get us out something that will do the business right off quick." It is needless to say I knew from past experience what "right off quick" meant, and was not slow in getting my cross-section paper into action.

The illustration shows the tube to be bent and a general view of the fixture for accomplishing the bend, as well as a larger scale sectional view showing the construction of the working parts. The body *A* is of cast iron grooved to the proper radius for the bend required, of such dimensions as to allow the tube to pass freely through the groove, and terminating in a straight portion tangent to the bending circle from two to four times the diameter of the tube in length. The shoe *B* is preferably of machinery steel grooved to comply with the form of body groove, and should exceed the developed length of the bend by some inches, and enough extra should be allowed so that a portion can be cut off for the gripping shoe *K*. The shoe *B* is guided by a flange on each side of the wheel *C*, which is of the proper diameter to fill in the distance between the shoe *B* and the stud *D* when the tube is in place, and should rotate freely on the stud attached to the bending lever, *L*.



A TUBE BENDER.

The action is simple and the success in bending is due to the tangential bend produced by the shoe *B*, the bend being always of as long a nature as possible.

I have bent both solid drawn and brazed tubing from ⅛-inch iron pipe to 2-inch 12-gage brazed steel tubing, and while I realize that the method has its limitations, it is also a cheap, efficient and rapid way of bending that has never failed to work.

When but one or two pieces are required, I have made a fixture of rock maple which stood up well and did the work required in a satisfactory manner.

V. A. H.

Mechanics as Machinery Salesmen.

Editor American Machinist:

Your correspondent Art. Isan at page 165 don't understand why mechanics in manufacturing plants are not made salesmen and advertisement writers in preference to office subordinates. He says: "The manager could help himself by calling in the shop man."

I think Art. Isan is wrong in his opinion as to what kind of material and experience is required to make a successful salesman. In the line of machine tools which he has taken up for text he says the young man from the vise or the lathe can certainly develop into a better salesman than the stenographer. In reply to this assertion I simply say that according to my experience he is wrong. I have been connected with the manufacture of machinery of all kinds for the past forty years—as foreman, superintendent and proprietor—and have run against salesmen of all types and all nationalities, and I am free to say that a mechanic who is practically master of his trade—no matter what branch of it—will make a failure as a salesman. There is not one mechanic in a hundred who has any business experience. Shopmen are generally so full of conceit and mechanisms that they have no space left for business ideas. I was superintendent of a tool works in this country for about ten years, and saw it grow from a small shop to perhaps the largest in the world. During that time I met salesmen from all over the country and in all lines. This company had a president who never bragged much about his mechanical ability

when at home, but away from home as a mechanic and a salesman he had no equal; and when this president quit the road and had to select salesmen to represent his company on the road he did not select mechanics. He brought to me one day a young man with a smooth face, about twenty-two years of age, well dressed and of good manners. This president told me to show him around the works, which I did, thinking he was the son of some railroad president from whom we were to secure a large order of tools. He had never been inside of a machine shop before in his life. I asked the president as soon as I met him who the young man was. He told me he was going to train him for a salesman—but at that time I was of the same opinion with Art. Isan when he wrote his article. My opinion has changed. That smooth-faced boy—for that was all he was—is to-day the secretary of the largest machine-tool company in the world, and I suppose receives a large salary. A little later another young man was brought to me to make a salesman of; he came out of the office of a glass works. He soon made a successful salesman and is to-day manager for a large machinery house. We had another experience in a man who is now known North, South, East and West, in town, city and hamlet, wherever a grindstone is turning. He never boasted much about his ability as a mechanic; he left the shop and assumed the role of a salesman, and it did not take long for him to catch on. He never allowed a contract to slip from him; he was "up and doing" night and day; I never saw or knew a better salesman. To-day he is president of the shop he traveled for.

And now for the other side. I knew a man who was a graduate of Yale College, had served his term at the machinist trade, was a skilled draftsman, and familiar with all details of machine tools. He was called on several times to go after a deal when the other man I have spoken of was busy. To make a long story short, he was a rank failure. He never made a sale. He did all the talking and started in at first sight to tell the possible buyer what he wanted, condemned all the tools the man had in his shop and the methods of doing his work. This is the type of salesman a mechanic makes.

I will tell a little story about a sale made by a smart fellow who was *not* "raised in overalls" and for which he was promoted. A company in his city was in the market for a large gum belt—I mean a long and wide belt. The young man secured the order and promptly sent it to the factory. In due time the belt was received and arrangements were made to put it in service. When the belt was unrolled it was discovered that it had a large hole in the center. The man who took the order was sent for at once, and as soon as he saw the hole he said, "It must be there for some good purpose, or it would not be in the belt." He convinced the superintendent to that effect, the belt was put to use, and in a few days the manager of the factory came on and agreed to send another belt at the same terms. This young man was made manager of the store, and is in that position to-day; he is not a mechanic.

JOSEPH H. SPRINGER, SR.

Protecting Plug Gage Ends.

Editor American Machinist:

The accompanying sketches show how the ends of plug gages may be protected from accidental bruises without detracting from their usefulness. Fig. 1 shows a projecting rim turned on the end about ⅛ inch high. It serves to stand the gage on and protects it from coming in contact with hard substances on the ground edge. Fig. 2 shows another method. In this case the bottom edge is reduced in diameter about 1-16 inch for about 3-32 inch deep, and a brass ring, Fig. 3, bored out 1-32 inch less than the ground surface of the gage and having a saw cut made diagonally across one side is sprung on. The ring has sufficient grip to hold it in place. These brass rings are very cheap to make and serve their purpose admirably.

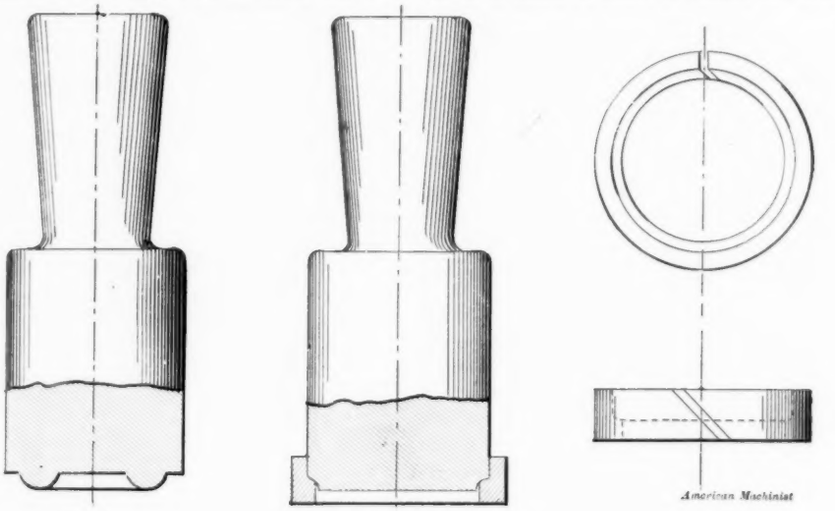


FIG. 1. FIG. 2. FIG. 3.

PROTECTING PLUG GAGES.

London, Eng. C. H. ALEXANDER.

That Eight-Hour Day Experiment.

Editor American Machinist:

At page 300 I notice an account of an eight-hour day experiment. It seems to me that this can only be successfully done on repetition work, the time of which has been previously established. As to gaining one hour in nine, I consider that, as a general thing, it requires very little effort on the workman's part to make this up, if he has been working day work. In saying this I do not mean to detract from his honesty, but I have had so many cases come under my observation where the men have surprised themselves in what they have accomplished. While thinking that they were doing about all that could be expected, if they were then given a time limit for the work, based on the best time made on the particular work in hand, often the same men did twelve hours' work in eight hours. I once carried this idea out into setting the time on each job of machine work when making tools and jigs, where every piece was different, and I had the chance to follow up the work. The men usually made 25 per cent. better wages, but it requires a great deal of time to follow it up, and also time in following each man on each piece.

For instance: I would make a sketch of a piece and put down the limit of time. Any time saved on this would be marked opposite the estimated time and would be paid for. If the man fell short of the estimated time he would still get paid for all the time spent on the job; but this failure would not be considered as definite proof that the time estimated was wrong. In view of the fact that the man is supposed to make an effort to reduce the time on the work in hand, on account of the premium, and has made an effort and failed, I consider he is at least entitled to his regular pay, for he has done more work in the time consumed in trying to earn the premium than he would have done in ordinary day work, and the employer is ahead even when paying him his regular wages. Everyone will have days when everything goes wrong, for one reason or another; at least I have found it so with the majority of people. On the other hand, it is possible to make a mistake in estimating on something that is unusual; but when a man has handled different classes of work and is conversant with all of the machines and their equipment of tools, and is further in a position to dictate the methods to be employed, it should be rare for him to make a mistake in his estimate of the time required.

I would like to see the comparison in the time on the same work done in the eight- and the nine-hour day, expecting, as I said above, that considerable more work could be done in the eight hours

with an incentive than in the nine hours without an incentive. But why not introduce the premium plan at once in such a shop where the time is evidently known for doing a certain amount of work, and get a greater production in a still shorter time out of the same amount of help and machines, thereby reducing current expenses per piece of work turned out?

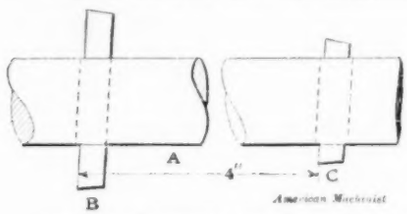
A. MERTES.

Grinding a Taper Reamer.

Editor American Machinist:

Having a taper reamer to grind 1½ inches taper per foot and not having a gage of correct taper, the following method was resorted to, based on the belief that the high point of a taper is the only one which can be accurately measured.

A piece of cold-rolled stock *A* was cut off same length as the reamer. This piece was centered and two 5-16 pins inserted as shown. The back side of pin *B* was then squared by grinding until there was a flat about ⅛ inch wide. The front side of *C* was then squared and the distance over the outside of the pins measured with a vernier. The back side of *C* was then squared to a thickness to be exactly 4 inches from back of *B*, as shown. *A* was then put in the grinder and the taper set by grinding the ends of the pins until the difference



METHOD OF GETTING CORRECT TAPER.

in diameter at high points was one-third the required taper—½ inch in this case. The reamer was then finished without altering the grinder.

By this method the whole job depends on a man's skill in making fine measurements, and if carefully done gives excellent results.

W. E. WILBER.

Complete Combustion of Coal.

United States Consul Guenther sends from Frankfort, Germany, an account of an address by Sir John Primrose at a recent banquet in Glasgow, Scotland, in which he told of a new process for the complete combustion of coal. Recently he tried a new furnace (as to who invented it we are not informed) which seems not only to prevent smoke but develops a much greater efficiency in the coal used. The speaker said of the invention that the burning of the coal takes place in a chamber surrounded by a water jacket, separated from the boiler, and that only the gaseous products of combustion are used for heating the boiler. According to this new process a steamer would require less than one-half of the room now used for the boilers in order to generate the same amount of power, and the weight of the heating apparatus would also be diminished more than one-half. Air and fuel gas are conducted simultaneously to the boiler and no unburned gases can escape into the air, so that no smoke and no carbonic acid escapes through the smoke-stacks. For steam purposes it would also be of importance, as it is said that the process permits of the use of inferior fuel.

The March Meeting of the American Society of Mechanical Engineers—Steel Rails.

The March meeting of the American Society of Mechanical Engineers, held at the society's house on Tuesday evening, March 29, was largely attended and profitable and enjoyable to all present. Mr. Julian Kennedy, of Pittsburg, gave a very complete story of the manufacture of steel rails, from the ore through all the processes to the finished product. Perhaps the most unsatisfactory part of all was the definition of steel, which was given at the beginning of the address. It was said that the old and once standard definitions of steel are, as everyone knows, more or less incorrect and unsatisfactory, and the best definition within Mr. Kennedy's knowledge he considered to be: "An alloy of iron which has been fused and which can be forged." A brief sketch of the chemistry of iron and steel was first given, and then the story was told by lantern slides explained in a conversational way. The slides embraced photographic views and diagrams, each fitting in to the series and following its predecessor so smoothly as to artfully conceal the care and thought which had been given to the preparation of the talk as a complete and well-balanced whole. The first views were of some of the iron mines where, after the top earth is removed, the ores are handled entirely by steam shovels, some of the ores running almost as fine as flour, which is rather a wonder to us who are having such a time trying to melt iron chips and shavings. Then interesting views were given connected with the transmission of the ore and its various "handlings," always with hands of iron with steam behind them, until it is poured into the blast furnace. The construction and operation of the furnace and of the Bessemer converter were described, then various rolling mills and the processes of rolling, the difficulties encountered and the peculiar and special problems to be solved were spoken of. The open-hearth process was not omitted and was spoken of as likely to continually grow in favor and in employment. The lecture was closed very neatly with a suggestion of a composite picture to be made of the superimposed portraits of the successive steel workers who have contributed to the wonderful development of modern metallurgy, and the final resolving of the prospective picture into an excellent likeness of John Fritz.

The next monthly meeting of the society will be held on Tuesday evening, April 26, when Rear Admiral George W. Melville, now in Europe, will discourse upon marine engines.

Gage Numbers Entirely Discarded by the Westinghouse Electric & Manufacturing Company.

The Westinghouse Electric & Manufacturing Company issues a small pamphlet entitled "The Gaging of Material" which is of unusual interest because it announces the adoption, by a very large buyer and user of material, of an advanced position with regard to these matters. This can hardly fail to exert a powerful influence for good. Regarding this pamphlet and what it represents, one who is prominently connected with the manufacturing end of the business makes the following statement:

The Westinghouse Electric & Manufacturing Company has issued a little booklet which sets forth its position on this subject. This booklet is to the effect that all gage numbers for materials which are ordinarily "gaged," with the exception of finished materials, will be dropped by this company in their specifications, correspondence, etc. By the retention of the existing dimensions used by the various gage systems, the company has endeavored to avoid the necessity of calling for special materials as would be required if a universal system were adopted. The Westinghouse Company, while earnestly desiring reform in the way of a universial system, such as the Master Mechanics' decimal gage, does not wish to introduce a series of sizes which will make it necessary for manufacturers to change their existing standards. The adoption of a universal system would also lead to great confusion in their own works, due to the fact that these gage systems have been in vogue for years and the changes which would be required would involve practically every design which the company has put out.

It is hoped that the step taken will gradually lead to a consolidation of the large number of dimensions which are in vogue into a single system where a comparatively few dimensions will cover the range necessary to use. It is not expected that this change will come about in the very near future, but by using the decimal system, this being constantly before the designers and manufacturers, it is hoped that it will eventually lead to the desired end without the necessity of making radical changes at once in a system which has connection with the manufacturers of almost every kind of material which is known by gage number.

The booklet, together with tables, shows the stand which the Westinghouse Company has taken and gives in detail the directions which they have given to their employees. They will also issue this booklet to manufacturers from whom they purchase materials which have heretofore been known by gage numbers.

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Let All See the Plans.

We have so great a personal interest, as have also so many of our readers, in the new union engineering house which is now being planned, and the erection of which will be so soon begun, that we may be expected to frequently refer to it as the occasions arise for doing so. Especially at the beginning is it proper to offer any suggestions that may by any possibility contribute to the perfecting of the results desired, and accordingly we welcome the remarks upon this topic in the current issue of the *Engineering Magazine*. It says:

"While there is no doubt that the best architectural skill will be employed in the design of the building as a whole, it must be remembered that there are numerous features in connection with which the architects may wisely consider the peculiar conditions involved."

These conditions it proceeds to enumerate and discuss in a wisely suggestive way. We cannot here go over the numerous suggestions in detail. It says in conclusion:

"These are but a few of the special requirements which may be readily provided if considered in advance of construction, but which would be found difficult and costly of attainment afterwards. A building for engineers should exhibit in every detail the latest evidences of engineering skill and judgment in construction and adaptation for its uses, and with all branches of the profession represented in its occupants there should be no difficulty in obtaining the best expert advice for every detail of the work."

We do not want primarily a splendid piece of architecture or a masterpiece of any individual architect. What is wanted is a building of many functions each of which it will best fulfill for all the societies and for every individual member. Of course, as a place of public meeting, a most imperative condition is that all shall be able to hear with ease. That this is not impossible we have positive assurance in Carnegie Hall in this city, where perhaps four times as many people are often gathered as will ever assemble in the engineering hall. It will be a disgrace to the engineering profession if a hall is not built with better acoustic properties than those of the main hall of *the* engineers of Fifty-seventh street.

While the hall or halls for the meetings of the societies, including those of the committees and the smaller gatherings, are the most prominent and the first thought of feature, we are far from asserting that it is of most importance, or that it should overshadow or in any way crowd or encroach upon any one of at least two or three others. Fortunately neither function need encroach upon the other, but much thought is necessary to combine the whole requirements satisfactorily. The building must embody arrangements which in their entirety have never before been satisfactorily adjusted in any single building. The preparation of the plans, therefore, is a work of unusual responsibility and of most exacting requirements. The work cannot be done straight through by any human being. The best is by no means the first thing thought of, nor thought of at all by one or a few. It will be well for as many as possible of those interested to know as much as possible of the plans as they mature and before they are irrevocably fixed. An exhibition of the plans cannot fail to provoke valuable suggestions and also stave off the worst manifestations of the inevitable grumblers and fault-finders after the fact.

The Simplification of Words.

In *The Munsey* of February last Brander Matthews has an article entitled "The Development of the English Language," which is far enough removed from anything pertaining to machinery and yet somehow this very interesting article by the professor of English Literature in Columbia University reminds us of some of the things that machine designers and machine builders have been doing during the past twenty-five years. They have been lopping off and rooting out mere ornamentation and superfluities of one kind and another; they have been simplifying and reducing things to a strictly functional basis. This is precisely what Professor Matthews advocates doing so far as possible with our English. He points out the fact that changes in spelling and in the meaning of words always have taken place and are now doing so, and he, believing, as he declares he does believe, that English is to become eventually the dominant language of the world, thinks we should do what we can to eliminate mere curlycues from it and to simplify it as much as possible. In doing this he points out that we need not feel called upon to be strictly consistent, but may simply go ahead and simplify the spelling of certain words, leaving other perhaps analogous words to be simplified later.

There is of course a literature of the mechanic arts. Machine builders are constantly producing, in the form of catalogs, specifications and technical articles, matter that is to be read and studied by others interested in these things here and abroad. Why is it not peculiarly appropriate that machinery men whose work in their own line shows so plainly their appreciation of simplicity and functional design should simplify their English as much as possible, at least so far as is unequivocally endorsed by such authority as is Professor Matthews, to say nothing of others? This endorsement covers the use of such spellings as catalog, program, meter, tho and altho. He says nothing of hight in place of height nor of sulfur instead of sulphur, but we have long used the former and for some time past sulfur has been used in works in chemistry and is used by the United States Patent Office. Needless to say Professor Matthews deprecates the reintroduction of the superfluous u in labor,

color, honor, etc., and he virtually throws open wide the door for reform and improvement by declaring that those who believe in avoiding the employment of useless letters should simply drop them and that the dropping of them may "afford fit occasion for explanation that there is no standard of spelling in English and that usage has always been shifting."

It seems to us peculiarly appropriate that the technical journals and technical and professional societies should take up these matters and not be the last to adopt reforms that are needed and that in the field to which they pertain are strictly analogous to the work done by engineers generally. We propose to progress a little along this line and assure those of our readers who may see the propriety of doing likewise that they will have the backing of the highest authorities.

Something for Almost Nothing.

Another remarkable invention for getting the best of Mother Nature comes to us from St. Joseph, Mo., and, as usual, a stock company has been formed to exploit it and erect a factory for its production.

The invention, we are told, "will doubtless prove the greatest invention of the twentieth century," a statement that shows large prophetic powers at least, and is a heater which is to "produce heat and power without combustion." It is to do everything that is now done with smoky coal at "less than one-half the cost" of "any other known process." There is to be no more going down to the cellar in the early morning and in abbreviated attire, with the thermometer 20 degrees below zero, to find the furnace fire out, the fortunate owner of the apparatus having only to turn himself over in bed and touch an electric button in order to start the apparatus and have the house warm and comfortable at breakfast.

The apparatus, which is the result of over twenty-three years of work prosecuted in the midst of "many seemingly insurmountable obstacles," is thus described by the St. Joseph *Press:*

"The principal parts of the mechanism are a double cylinder, and a spindle, not unlike a wire gun cleaner. In the working model now on exhibition in the basement of the First National Bank building, the cylinder is about 3 feet in length, and the spindle, which revolves inside of it, is of equal length. The cylinder is about 12 inches in diameter; the spindle 6 inches in diameter. Inside the outer jacket of the cylinder is another smaller cylinder of brass, the space between being filled with water. Inside this smaller cylinder revolves the core or spindle, which rubs against the brass casing, creating the friction which heats the water.

"The motive power used in producing the friction, which produces the heat in this friction heater, may be electricity, gasoline, gas, water, wind or any other power, and the power required is very light. In the case of street cars, railroad cars, automobiles and carriages the heater can be attached to the axle, and the revolution of the wheels of the vehicle will furnish the motive power."

Our readers are well-known to be afflicted with that superior knowledge which sometimes scoffs at the productions of unknown inventors. Should they be skeptical about this one we will remind them that Dr. Lardiner is said (untruly, to be sure, but that does not injure the story) to have predicted that a steamship could not cross the Atlantic. Moreover, the invention is patented "throughout the civilized world," and what better proof of merit could it have than that? Knowledge of nature's laws has, of course, a certain degree of usefulness. When an invention is of limited scope or is merely a new application of old principles, such knowledge has been known to detect fallacies and point out pitfalls, but there are cases when the broader view of pristine ignorance is necessary to the comprehensive sizing up of a revolutionary invention. In the present case we are told that the invention "is destined to revolutionize all ideas with reference to the methods of producing heat and power." Under such circumstances a knowledge of a few fundamentals is of no avail—at any rate of no avail in convincing a few promoters and investors that they are engaged in a wild goose chase. It is necessary to wait until someone has exchanged some good money for some equally good experience.

A Comparison Without Meaning.

Some comparisons have been made between the incomes, cash capital, expenditures, etc., of the United States Government which we think are liable to cause some misunderstandings and to becloud things somewhat. To quote one writer on financial matters:

"It appears that while the assets of the United States Steel Corporation are $1,583,845,298, the amount of cash in the United States Treasury is $1,413,110,668. The combined capital stock and the bonded indebtedness of the Steel Trust are $1,436,722,135, while the interest-bearing debt of the United States is $901,470,950. The combined dividend and interest payments of the Steel Corporation amounted last year to $68,748,392. The interest payments of the United States Government were $28,556,348. The gross earnings of the company were $536,572,871, and the income of the United States was $560,396,674. The operating expenses of the Steel Trust were $409,268,599, and the expenses of the United States Government were $477,542,659. The year's surplus was $12,304,916 and the estimated surplus of the government will be $14,000,000."

We do not see that such a comparison means anything whatever. The government is not carrying on manufacturing operations to any great extent, nor is the United States Steel organization carrying on governmental administration. The work done by government officers and employees is for the most part entirely different from and with a different object than that done by the officers and employees of the United States Steel Corporation.

That one happens to receive or to spend more cash than the other seems to us to be of no particular importance, tho of course it may be, in a certain way, mildly interesting. The power and strength of the government do not depend upon the amount of money it handles, but upon the moral support given it by its citizens generally.

The Summer School of the University of Wisconsin.

The fourth annual session of the Summer School for Artisans held under the direction of the College of Engineering of the University of Wisconsin begins June 27, and continues for a period of six weeks.

Courses of study are offered in the following subjects:

Steam, Gas and Other Heat Engines—Lectures on the theory of heat, the operation and methods of testing steam, gas and air engines, boilers, compressed air and refrigeration plants.

Applied Electricity—Theory of direct and alternating current dynamos and motors, the operation and methods of testing electrical machinery, batteries, transformers and other apparatus, photometry and calibration of instruments.

Mechanical Drawing and Machine Design—Elements of applied mathematics, courses in mechanical drawing and machine design adapted to the preparation of the students.

Materials of Construction, Fuels and Lubricants—Lectures on the properties of materials accompanied by laboratory tests; lectures on fuels and lubricants with laboratory tests on the heating value of coals and efficiency of lubricants.

Shop Work—Practice with hand tools, wood- and metal-working machinery, and in blacksmithing and patternmaking.

The requirements for admission do not extend beyond a working knowledge of English and arithmetic, but the policy is to allow a large amount of individual work, so that the student may take advantage of all the preparation he has obtained.

One of the leading purposes of this school is to supplement the work of the correspondence schools by extending to the students of such schools facilities for laboratory and shop practice. In past years many of the students of the summer school have been of this class.

The entire necessary outlay for living expenses and school fees for the six weeks' term is estimated at $50. The fees are alike to residents of all States.

Another difficulty which may prove a serious one is reported in connection with

the erection of the proposed engineering building. It seems that one of the two lots on Fortieth street, where the Engineers' clubhouse was to have been erected, is subject to the provisions of a will made in 1872 which restricted the property from ever being used for other than residential purposes. Other property in the same block is tied up in the same way, and recent efforts to release it have brought out a decision sustaining the provisions of the will as to all the properties involved. In the case of one residence which in the absence of an adjoining property owner was altered over to fit it for business purposes the decision is that it must be restored to its former condition. Of course as the matter now stands the interests of present owners of property are concerned and their rights are likely to be maintained by the courts if they choose to contend for them.

The question arises as to what should be the proper course for the clear designation of the various kinds of shapers. For a long time it has been understood that the term "crank shaper" meant a shaper in which there is a crank above the ram and usually fitted with a Whitworth quick-return motion. The other form of shaper in which there is a slotted lever below the ram by which the quick return is obtained has usually been called a "pillar shaper" to distinguish it, notwithstanding the fact that this style of shaper has, as a matter of fact, a crank also. Recently there seems to be a tendency among builders to call the pillar type of shaper a crank shaper without any further designating term. This has led to confusion which is likely to increase, and it would seem better to call the latter type of shaper a "pillar crank shaper," perhaps, or at least something which will indicate by its name that it is different from the particular style of shaper which has always been known as the "crank shaper."

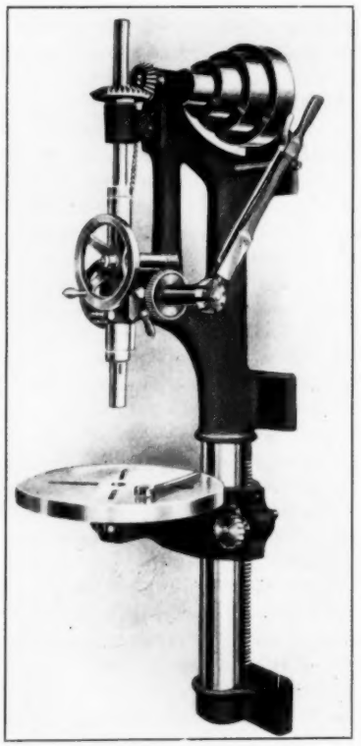
Advertising managers representing various manufacturing establishments in Cleveland have formed an organization to be known as the "Manufacturers' Advertising Club" and in which it is proposed to have papers read from time to time by advertising experts. The president of the club is Mr. Chas. B. Shanks, of the Winton Motor Carriage Company, and its secretary, Mrs. F. A. McIntosh, of the Standard Tool Company.

The National Electric Company, of Milwaukee, successor to the Christensen Engineering Company, has fitted up dining rooms and a kitchen for its officers, office employees and heads of the mechanical departments. Meals will be served at noon free of all charge, the company expecting its return in the way of better understanding resulting from meetings at table, and in a somewhat shorter noontime cessation of work than now prevails.

Some New Things.

A NEW POST DRILL.

The half-tone shows a new wall or post drill made by Boynton & Plummer, Worcester, Mass. There are many spots about a shop where it would be convenient to

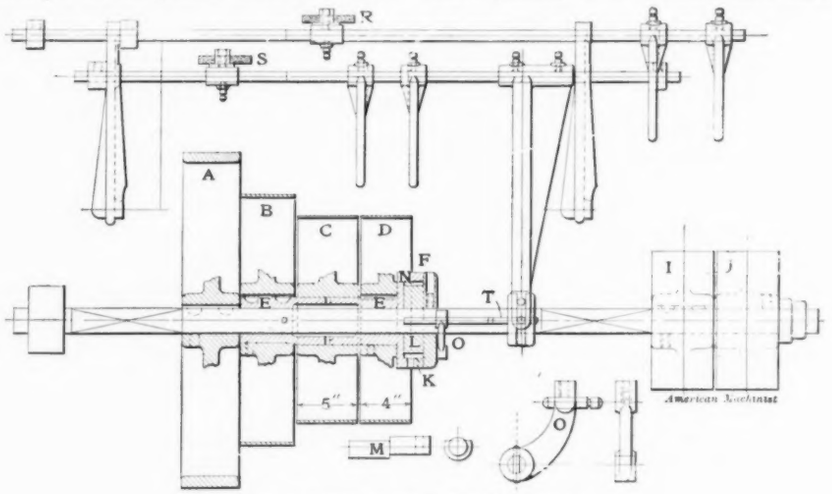


A NEW POST DRILL.

set up and use such a drill as this, but where a regular floor drill could not find room. None of the desirable features of a handy drill are sacrificed in the arrangement, and the drill is of sufficient size and strength for the general work of the average shop. It drills to the center of 24 inches, the spindle having a vertical movement of 11½ inches, while the table has a transverse of 18 inches, so that 24 inches can be secured between spindle and table. Drills can be as large as 1½ inches. Both lever and screw feed are provided, with instantaneous change from the one to the other. The spindle has a No. 3 Morse taper socket, and its weight is counterbalanced. The cams take a 2¾-inch belt, and the countershaft, which runs at 230 turns per minute, has 10-inch tight and loose pulleys for 3-inch belt.

A TWO-SPEED PLANER COUNTERSHAFT.

The cut shows a new planer countershaft by means of which the operator has at instant command two different cutting speeds while retaining a constant backing speed. The large pulley *A* which drives the backing train of the planer is keyed to the countershaft, which is stopped and started by the shipper lever at *R* controlling the belt to the tight and loose pulleys *I* and *J*. The pulley *B*, which is the driving pulley for the cutting stroke of the planer, is secured upon the end of a long sleeve fitted to turn freely upon the shaft. Next to pulley *B* and upon the same sleeve is the loose pulley *C* and next to that the pulley *D* keyed to the sleeve, and at the outer end of the sleeve is the friction clutch *F* by the action of which the sleeve may be locked to the shaft. The sleeve, driven by pulley *D*, and the shaft driven by pulley *I*, run at different speeds, say 200 turns for the former and 500 for the latter, or any other speeds most suitable. It is not necessary to describe the clutch in detail. The hub *L* is keyed to the shaft and this is overhung by part *N* of the sleeve. Between these in the space *K* is a split ring, one end of which is pinned to *L*, the periphery of this ring normally just clearing the inner surface of *N*. By the action of the lever *O* on the outer end of the tumbler *M* the ring is distended and sleeve and shaft are securely locked together. In doing a job of heavy planing or in working hard material where the slower speed is required the belts are thrown on to *D* and *I* respectively. To run at the higher speed for a finishing cut the belt remains on *I* as before, but the belt at *D* is thrown on to the loose pulley *C*. It will be noticed



A TWO-SPEED PLANER COUNTERSHAFT.

that the face of this pulley is wider than that of *D*, so that when the belt is off the face of *D* the shipper is at liberty to move an inch or so farther. In moving this short distance the projecting wedge at *T* acts upon the adjustable screw point in lever *O* and operates the clutch. When the shipper is withdrawn enough to release the clutch the belt is still running upon the loose pulley *C* and the cutting drive of the planer is stopped. This countershaft has been tested with overloads and rough usage, and has been found satisfactory and reliable. It is made by the Cincinnati Planer Company, Cincinnati, Ohio, and can be furnished with their planers.

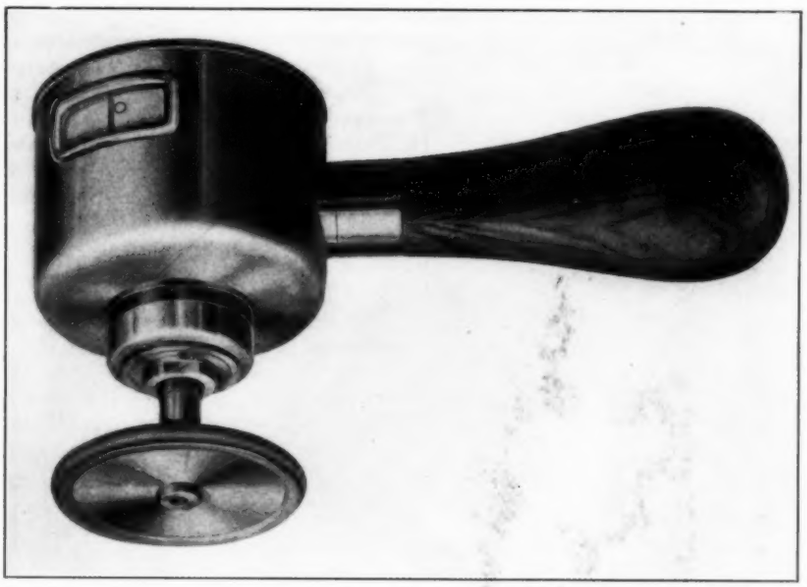


FIG. 1. A CUT METER FOR MACHINE TOOLS.

A CUT METER FOR MACHINE TOOLS.

The advent of high-speed steel has made pressing the need, which has always existed, for an instrument for determining the speed of work and tools in machine shops and we show herewith an instrument called very appropriately a cut meter, which seems to meet all requirements and in a very neat and effective way.

The instrument is essentially a tachometer, having such a relation between the graduations and the diameter of the driving wheel that the graduations read in feet per minute traveled by the circumference of the wheel instead of, as usual, in revolutions per minute. It is hence only necessary to hold the instrument with the rubber-tired wheel in contact with the work, when the graduations—seen through the window in Fig. 1—give directly the surface speed in feet per minute. The instrument is perfectly balanced in all positions and hence may be applied to a horizontal piece of work in the lathe, to the shank of a drill in a drill press, to the table of a planer or to any other tool or piece of work, however it may lie.

The instrument operates upon a principle which is new in such tools and which will be understood from the section Fig. 2. The rubber-tired wheel *a*, through the shaft *b*, revolves the permanent magnet *c* at a speed determined by that of the piece being tested. The magnet *c* is in ring form with a very small air gap, as shown in the small detail at the left. Above the magnet is a partition *d* supporting the lower bearing of the shaft *e* which carries a thin aluminum disk *f* above which is a soft steel ring *g*. The lines of force from the permanent magnet take the direction shown by the arrows in the detail view and, during the revolution of the magnet, generate eddy currents of electricity in the aluminum disk, the result of which is a dragging force tending to rotate the disk, which action is proportional to the speed of rotation of the magnet. The tendency to rotate the disk is resisted by the hair spring *h*, the law of which corresponds to that of the applied force—that is, the twisting of the spring is proportional to the force applied. The turning of the disk is thus a measure of the speed and, moreover, the scale which indicates it is uniformly divided throughout its length.

The workmanship of the instrument is of precision grade throughout. The main shaft runs in ball bearings and the shaft of the aluminum disk is supported in sapphire jewels. The magnet is of special magnet steel and is magnetized, tested, aged and then retested, those which show any loss of magnetism being rejected. The calibration is effected by turning the ball bearing cage which, being threaded externally, causes the magnet to approach or recede from the disk and thus its action on the disk is adjusted. This adjustment is made by a special key wrench in the hands of the makers only, the adjustment being made once for all when the instrument is completed. The partition *d* protects the disk from the influence of the air

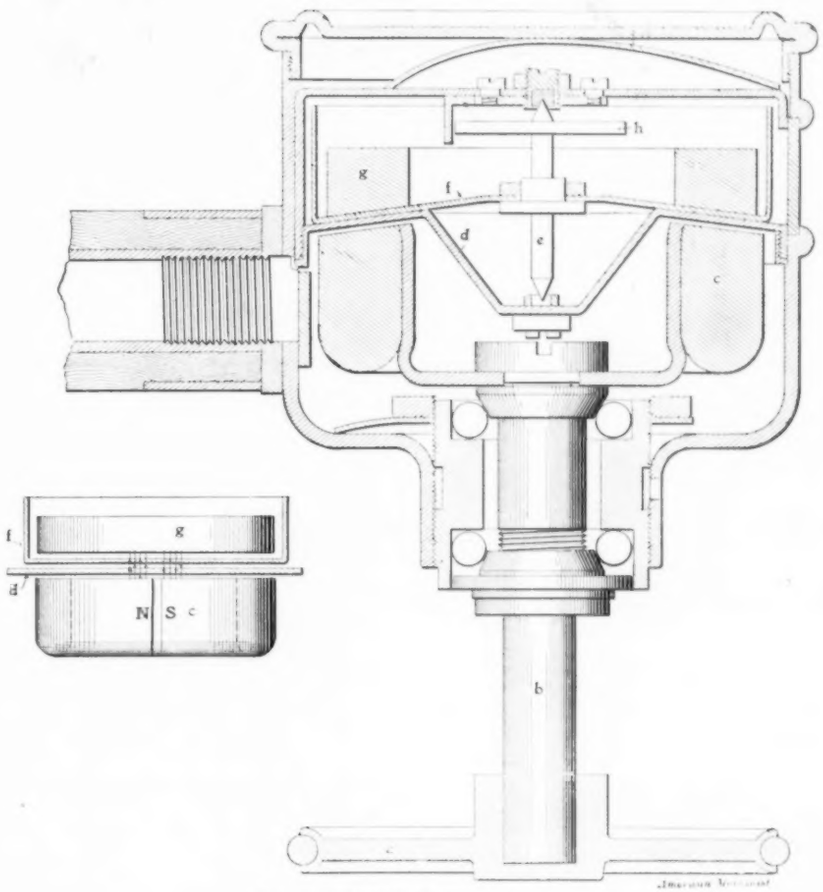


FIG. 2. SECTION OF CUT METER.

currents generated by the revolutions of the magnet.

The instruments are normally graduated to read up to 250 feet per minute, each division of the scale indicating 5 feet, but finer readings may be made by estimation.

The same principle is obviously applicable to tachometers reading in revolutions per minute, and it is the intention to follow this instrument by one of that character. The present instrument, being portable, there is no occasion for making it to read in both directions, but the tachometers will be made to so read.

The instrument is the product of the Warner Instrument Company, Beloit, Wis.

A TEN-FOOT BORING MILL.

At page 1412, Vol. 26, we gave some illustrations of an 8-foot belt-driven boring mill made by the J. Morton Poole Company, of Wilmington, Del., and we show herewith the 10-foot machine as arranged for motor driving, including additional features of the cross-rail elevating mechanism.

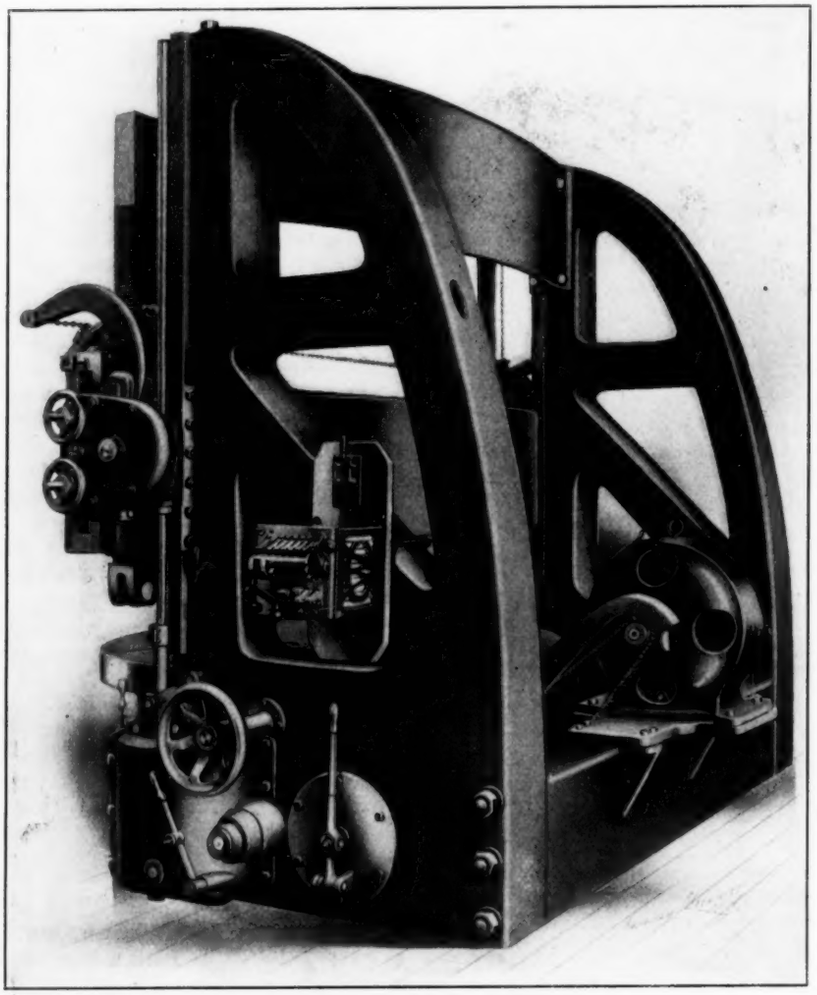


FIG. 1. TEN-FOOT BORING MILL.

The motor used may of course be of any make having suitable power and regulating properties. The one shown is by the Crocker-Wheeler Company, and has a 50 per cent. speed reduction, in addition to which four ratios of back gearing are provided. The driving of the table is by a Hindley worm gear. The motor also performs all functions of elevating the cross-rail, traversing the tool heads and raising and lowering the tool bars, while the changing of table speeds and tool feeds is accomplished by the manipulation of levers and hand-wheels.

The driving chain gear runs loose on the back gear shaft, and may be engaged directly with it by pulling out the lever shown at the extreme right of the base in Fig. 1, while by pushing this lever in, a back gear ratio of one to eight is obtained. The back gear shaft carries two gears which drive loose friction gears on the

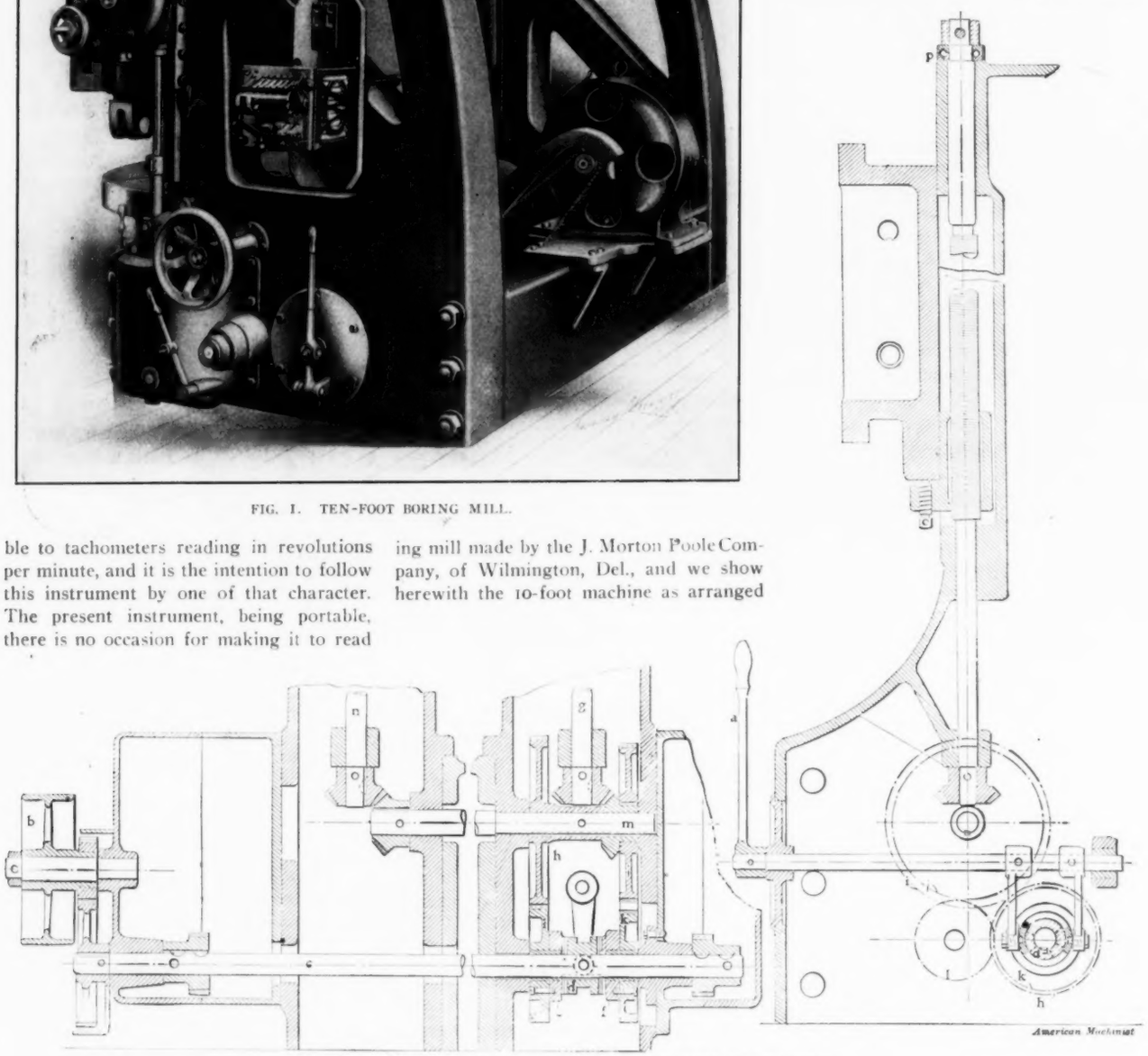
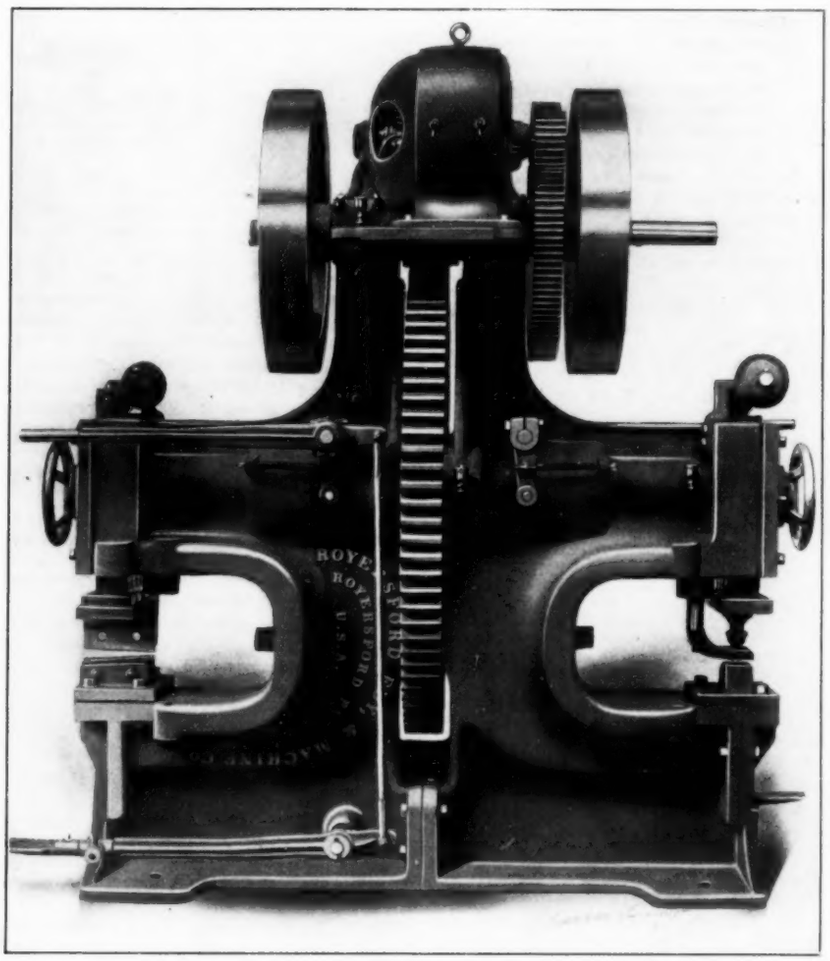


FIG. 2. SECTIONS SHOWING CROSS-RAIL ELEVATING MECHANISM.

worm shaft at ratios of one to one and one to three, these friction gears being engaged by turning the hand-wheel projecting from the base in one or the other direction. The combination of lever and hand-wheel gives the four back gear speeds which, in combination with the variable motor speeds, give a range of table speeds of from ½ to 24 revolutions per minute.

The vertical lever at the left of the electrical controller gives four rates of power feed and a quick traversing speed to the right-hand head, while the inclined lever below the hand-wheel gives four additional rates of feed. Similar levers upon the other side of the machine perform the same functions for the left-hand head. Of the two hand-wheels on the end of the cross-rail the upper engages and disengages the movement of the tool bars and the lower of the tool head, similar hand-wheels upon the other end controlling the same movements of the left-hand tool. The lever of which the end is seen projecting above the gear box, shown also as *a* in Fig. 2, controls the elevating and lowering of the cross-rail. This illustration shows the machine as arranged for line shaft driving, the power for elevating the cross-rail being delivered to the pulley *b*. When the machine is motor driven, this pulley and the connecting gearing are removed, the shaft *c* being driven from the back gear shaft by means of a silent chain within the bed.

Lever *a* controls the movement of the cross-rail by engaging the clutch *d* with one or other of the mating clutches *e f*, which, through the gears shown, drive the elevating screw *g*. Gears *h* and *i* are connected direct, while *j* and *k* have an idler *l* between them and the screw is thus made to turn in either direction, as desired. Shaft *m* extends through the bed and thus drives the screw *n* at the opposite upright. At *o* is shown an adjusting screw for alining the cross-rail with the table. As the weight to be lifted is about 12,000 pounds, the elevating screws are suspended by ball bearings of which one is shown at *p*.



COMBINED PUNCHING AND SHEARING MACHINE.

COMBINED PUNCHING AND SHEARING MACHINE.

The accompanying illustration shows one of a line of motor-driven combined punching and shearing machines made by the Royersford Foundry & Machine Company, of Royersford, Pa.

The motor, which is of the Crocker-Wheeler make, is well out of the way and applies the power between the flywheels without greatly increasing the distance between them. But one gear reduction is used between motor and flywheels, and the placing of the flywheels on the second shaft, while giving sufficient flywheel effect, protects the first pair of gears from the shock due to the effort of the wheels. The main gears are of steel, while the motor pinion is of rawhide. The clutches have both hand and foot control. The machine shown has an 18-inch depth of throat on both sides and has lower jaw pieces which may be removed to facilitate the punching of I-beams and channels. On the shear side the machine is capable of cutting a length of 6 inches through ¾-inch plate, or of cutting 1¼ round bar, while on the punch side it will punch 1-inch holes through ¾-inch iron.

The article entitled "Milling Machine Feeds and Speeds," published at page 409, was a paper read by Fred H. Holz, Jr., before the St. Louis Metal Trades Association. Statement of that fact was inadvertently omitted in connection with the paper.

It is reported that the American Locomotive Company has secured control of the Rogers Locomotive Works in Paterson, N. J., and considerable interest is manifested in the question of what is likely to be done with the works. Citizens of Paterson have done a great deal to keep the works going, and with that end in view some property has been given to the company which has been operating it. It is feared that the "locomotive trust" will shut the works down, and if it really has secured control of it we should think that would be the most likely course.

Personal.

Charles Waterman, superintendent of the Bradley Manufacturing Company, Allegheny, Pa., has resigned to take effect April 1. Mr. Waterman was associated with the Armington & Sims Engine Company, Providence, R. I., for a number of years.

The Canadian Westinghouse Company, Limited, of Hamilton, Canada, has recently engaged C. C. Starr, who was formerly connected with the firm of John Starr, Son & Co., to act as its representative in the maritime provinces, with headquarters at 134 Granville street, Halifax, Nova Scotia. The maritime provinces are included in the district of the Canadian Westinghouse Company's Montreal office, and Mr. Starr will be consequently an attaché of that office.

Business Items.

The Diamond Match Company, with a view of testing the efficiency of the Reeves variable speed transmission, placed an order with the manufacturer, Reeves Pulley Company, Columbus, Ind., early last fall, for one transmission. After giving it a rigorous test in its factory at Barberton, Ohio, for a period of over six months, it decided it was entirely practicable and recently placed an order for six more machines. As fast as convenient it expects to make further installations of these

transmissions, until eventually its plant will be equipped with them throughout. The Philadelphia office of the B. F. Sturtevant Company has also just placed an order for fifty Reeves transmissions. The Sturtevant Company uses them on its rotary cement kilns and coal conveyors.

Manufacturers.

Canton (Ga.) Cotton Mills will enlarge their plant.

Fire has destroyed the Fort Worth (Tex.) Planing Mill.

Chinnabee Cotton Mill, Talladega, Ala., will add 1,500 spindles.

Penn Yan, N. Y., is agitating a municipal electric lighting plant.

A factory is being built at Philadelphia for the Meade Roofing Company.

A plant of the Smyrna (Del.) Shirt & Hosiery Company has been burned.

The Hanover Plow & Handle Company is to enlarge its plant at Hanover, Pa.

Eugene Sheer, wagon and carriage maker, Lincoln, Ill., may build a new factory.

John B. Ross & Co., Charlotte, N. C., are about starting to build a bagging factory.

The Acme Mills Company, Portland, Ore., proposes to build a breakfast food factory.

It is planned to enlarge the plant of the Home Pride Range Company, Marion, Ind.

Decatur, Ind., hopes to get Toledo, St. Louis & Western Railroad Company shops.

The estate of H. N. Slater will greatly enlarge its textile mills at East Webster, Mass.

The Pelham (Ga.) Oil & Fertilizer Company will immediately rebuild burned plant.

The Johnston Railway Frog & Switch Company, Chester, Pa., will build an erecting shop.

Bremer & Bielenberg, cornices, Chicago and Elgin, Ill., are to increase their facilities at Elgin.

A. J. Henry & Co., cash register supplies, Camden, N. Y., will double their factory this spring.

A. L. Bassett and W. H. S. Harris have been promoting a canning factory for Jonesville, S. C.

The factory of the Manetta (Cotton) Mills Company, Lando, S. C., has been largely destroyed by fire.

The plant at Batavia, Ill., of the Challenge Wind Mill & Feed Mill Company has been damaged by fire.

The American Cereal Company, of Chicago, Ill., has decided to locate a factory in Battle Creek, Mich.

A serious fire has occurred at the plant of the Brewster Cocoa Manufacturing Company, in Jersey City, N. J.

A large paper mill may be established in St. Augustine, Fla., by H. G. Otis, of the Los Angeles (Cal.) *Times*.

Walworth Bros., Lawrence, Mass., manufacturers of dress goods, are about to erect a two-story mill, 60x200 feet.

The International Acheson Graphite Company, Niagara Falls, N. Y., will enlarge its plant greatly this summer.

The Waterloo & Cedar Falls Union Mill Company will, it is understood, overhaul its flour mill at Cedar Falls, Ia.

A big knitting mill may be established at Columbus, Miss., through the co-operation of the Citizens' Progressive Union.

A factory building of W. M. Crane Company, manufacturer of gas stoves, etc., New York city, has been gutted by fire.

The W. M. Ritter Lumber Company, of Columbus, O., proposes to build a large cigar box lumber mill at Kenova, W. Va.

The Central Machine Company, Niagara Falls, N. Y., has asked permission to erect a new plant, two stories, 60x120 feet.

The Fitzgibbon Boiler Company, Oswego, N. Y., contemplates a new office building and has some idea of enlarging its shop.

Plans have been filed for a 319x42-foot addition to a shop of the Cramp Ship & Engine Building Company, Philadelphia, Pa.

It is proposed to enlarge the plant of the Beaumont Manufacturing Company, twines and carpet warps, Spartansburg, S. C.

C. Ehmann & Co., Chicago, will remove their wooden mantel plant to Decatur, Ill. The main building will be 320x70 feet.

The Chattanooga (Tenn.) Roofing & Foundry Company is completing an addition to its pattern and wrought-iron department.

The Western Electric Company, Chicago, Ill., and elsewhere, will erect a plant at Eleventh and York streets, Philadelphia.

The C. R. Harper Manufacturing Company, blacksmiths' tools, Marshalltown, Ia., has commenced erection of a factory building.

The Rock Manufacturing Company, Rockville, Mass., textile goods, is to build an addition, 300x30 feet, on the old Leeds mill.

W. J. Rainey, coal and coke, Cleveland, O., and elsewhere, is building a new machine shop and foundry at Mount Braddock, Pa.

A meeting has been held at the Commercial Club, Terre Haute, Ind., to discuss a heating plant. M. W. Hanna is promoting it.

The Fishel Brewing Company, Cleveland, O., intends to build a plant. It has opened offices at No. 418 Society for Savings Building.

It is stated at Benwood, W. Va., that the Wheeling (W. Va.) Steel & Iron Company will about double the capacity of its tube plant.

A machine shop of the Pittsburg Valve Foundry & Construction Company, at Twenty-sixth street, Pittsburg, Pa., have been burned.

The J. R. Montgomery Company, Windsor Locks, Conn., manufacturer of cotton warps and novelty yarns, plans the erection of a big addition.

The William J. Hooper Manufacturing Company, Baltimore, Md., has contracted for its new net, twine and rope mill, four stories, 80x195 feet.

Lanesboro, Minn., is to have a large canning factory, due to efforts of Milo White, of Chatfield, and O. M. Levang, of the Lanesboro *Leader*.

F. A. Blank is promoting a factory at Smithton, Pa., to make the Barlow knives, etc. His address is not given, but may be Greensburg.

E. W. Penley, Auburn, Me., proposes to build a $75,000 meat-packing plant with artificial refrigeration and an electric light and power plant.

The Perkins Machine Company, South Boston, Mass., is fitting up a new shop in Warren. We lack definite details of the company's plans.

It is stated at Naugatuck, Conn., that St. George's Lithuanian Society expects soon to build a cotton and woolen goods factory on Linden Park.

The Allis-Chalmers Company is moving the Dickson plant at Wilkesbarre, Pa., to Scranton. The Dickson plant at Scranton has been enlarged.

Joseph Boyer has bought land at Detroit, Mich., adjoining the works of the Chicago Pneumatic Tool Company; object of purchase unknown.

A complete foundry and machine plant is to be built by the Liberty Supply Company, of Waynesboro, Pa. The main building will be 60x360 feet. J. O. Crawford, of Waynesboro, is general manager.

John S. Hughes, of Le Sueur, Minn., is to build and manage a canning factory at or near Cannon Falls, for the Cannon Valley Canning Company.

F. J. Brauer, a carriage manufacturer, has bought ground on Commerce street, New Haven, Conn., for a two-story building to be erected in the fall.

A two-story factory, 35x142 feet, and a boiler and engine house, 55x39 feet, are to be built in Newtown, Pa., for the Excelsior Spool & Bobbin Company.

The Woodstock Cotton Mills, of Anniston, Ala., have increased their capital stock from $100,000 to $250,000, which is said to indicate mill enlargement.

For beginning construction of a power-house for the office building of the national House of Representatives, $130,000 is recommended as a new item.

The Preston-Bell Company, recently formed with big capital for manufacturing furniture in Manitoba, has commenced to build its first factory at Fort Frances.

A factory building, 100x63 feet, will be erected in Dorchester for Charles F. Baker & Co., of Boston, Mass., manufacturers of wire nails and rubber cement.

Plants of the Racine Knitting Company, of Racine and Beloit, Wis., have been sold to Fred C. Lorenz, of Milwaukee, who proposes extensive improvements.

A meeting of Youngstown, O., merchants has been held in the rooms of the Retail Grocers' Association, to discuss a co-operative light and power plant.

Representatives of the Standard Electric Company, Cincinnati, O., have been looking for a location for an electric apparatus manufacturing plant in the South.

Work is beginning on a factory at or near Alden, Ia., by the Wood's Rapid Dirt Loader Company. The Waddell spreader is to be manufactured at the same plant.

Scranton, Pa., capitalists—John A. Mears, W. P. Boland and C. E. Chittenden—are organizing the Perfection Knitting Mills with a capital approximating $100,000.

Fond du Lac, Wis., common council has accepted the bid of the Citizens' Light, Heat & Power Company, of Milwaukee, for a franchise and a new electric lighting and power plant.

J. I. Pittman, of Valdosta, Ga., has invented an apparatus for extracting turpentine and the bi-products from pine stumps, etc., and will, it is said, put up a plant there.

George W. Kavanaugh, James E. McLaughlin and Frederick W. Kavanaugh, cotton and woolen goods manufacturers, of Waterford, N. Y., contemplate building a branch mill in the South.

N. F. Griffiths, of New York, with a company of capitalists of Nashville, Tenn., is preparing to erect a storage house at a cost of nearly $200,000. We infer that it will be cold storage.

G. M. Parks Company, steam and gas fitter, Fitchburg, Mass., has started the foundation of a building about 80x40 feet, three stories. The first floor will be a machine and pipe shop.

A Pittsburg building permit has been granted Hubbard & Co. for a factory building at Sixty-second street, to cost $12,000. There is a firm of that name in the shovel manufacturing business.

A building in Chicago, Ill., owned by the J. H. Dawson machinery concern and occupied by it, also by the Machine Perfecting & Manufacturing Company and others, has been damaged by fire.

A six-story building, 80x350 feet, will be added to the plant of Furst Bros. & Co., Baltimore, Md. It will be equipped with machinery for the manufacture of picture frames, molding, etc.

The Buffalo (N. Y.) Box Factory is to be rebuilt. The principal building will be 100x300 feet, four stories and basement, and there will be a 38x40-foot electric power house, a dry kiln, etc.

Plans have been prepared for a five-story, 75x126-foot factory building for the Broadbent & Davis Mantel Company, Baltimore, Md. A boiler-room, engine-room and electric plant will be built adjoining.

The Lee (Mass.) Electric Company is doubling the capacity of the central power-station. A 225 horse-power boiler has been ordered. It will be followed another year by new generators and engines.

J. B. and A. B. Floyd have organized the Puritan Cotton Mills & Electric Company to operate the Eatonton (Ga.) Electric Company's cotton mills, which they recently bought. Improvements will be made.

Montavilla, Ore., may have a $25,000 chair factory. The promoter is Mr. Gay, formerly connected with a Portland manufactory. William Deveny, secretary of the Montavilla Board of Trade, is in touch with the project.

The Old Dominion & Great Falls Railway Company, which is building a line from the Washington, D. C., side of the Aqueduct bridge up the Virginia side of the Potomac to Great Falls, has purchased a power-house site.

There is a rumor that the Henry Electric Equipment Company, owner of the Henry patents for self-lighting railroad and street cars by electricity, will erect a factory in Denver, Col., the first investment to involve $200,000.

The Nivison Glass Company, a new concern, has secured ground in South Baltimore, Md., on which, it is said, a $50,000 glass plant will be built, to make bottles chiefly. Henry P. Nivison was at the head of Nivison & Weiskopf, Cincinnati, O.

An electric plant is proposed to be built on the Penobscot, near Marsh Rips, Me. Land has been conveyed to John Conners, and George T. Sewall, of Old Town, *et al.*, parties more or less connected with the interests presumed to be behind the project.

There has been organized in Norfolk, Va., the American Brazing Company of Virginia and North Carolina, to establish a plant using the Pich process. W. H. Robinson is president; E. C. Hathaway, vice-president; G. H. Lewis, treasurer, and W. H. Venable, secretary.

The Midvale Steel Company, Nicetown, Pa., is preparing to erect a tempering plant which will include a main building, 504x68.9 feet; a furnace shed, 432x68 feet; a gas house, 378x32 feet, to the center of the columns with a retaining wall, 18 feet to the north and 296 feet to the south.

Now that the Allis-Chalmers Company has become affiliated with the Bullock Electrical Manufacuring Company, there is a report that $500,000 will be spent in enlarging the latter's plant at East Norwood, O., but this story is quite likely founded on improvements already under way.

Plans have been prepared for a six-story and basement, 85x100-foot factory building for the Johns Hopkins Hospital, Baltimore, Md. Before the fire the building on this site was occupied by the Sea Gull Specialty Company, manufacturer of baking powder, etc., which may take the new one.

A water-power plant is proposed to be built about ten miles below Joliet, Ill. It is backed by what is known as the Harlow A. Griswold syndicate, of Chicago. The preliminary details have been managed by Attorney C. A. Munroe, of that city. The new concern proposes to spend $1,000,000. It is believed that a fall of 14 feet can be obtained and eventually 20,000 horse-power developed.

New Catalogs

Eck Dynamo & Motor Works, Belleville, N. J. Price list of Eck multipolar motors and dynamos for direct current. Illustrated.

Sprague Electric Co., New York. Bulletin No. 103 of dynamotors and motor-generator sets. Illustrated. 9x7, pp. 8, paper.

H. H. Franklin Manufacturing Company, Syracuse, N. Y. Catalog descriptive of the 1904 Franklin motor cars. 5x7½, pp. 12, paper.

Lee Injector Manufacturing Company, Port Huron, Mich. 1904 catalog of Lee injectors and other steam specialties. Illustrated. 5x8, pp. 48, paper.

Westinghouse Electric & Manufacturing Company, Pittsburg, Pa. Circular No. 1059, "Electric Motor-Vehicle Equipments." Illustrated. 7x10, pp. 23, paper.

Wm. G. Le Count, South Norwalk, Conn. Price list of machinists' tools, including dogs, clamps, expanding mandrels, jack screws, etc. Illustrated. 3½x5, pp. 23, paper.

F. E. Reed Company, Worcester, Mass. Descriptions of 16- and 20-inch special turning lathes and a list of 201 educational institutions using lathes made by this company.

New Era Gas Engine Company (formerly New Era Iron Works), Dayton, Ohio. 1904 catalog of "New Era" and "Little Giant" gas and gasoline engines. Illustrated. 6¾x9, pp. 39, paper.

Clarence H. Booth (successor to the Steel Bath Manufacturing Company), Detroit, Mich. Catalog describing and illustrating Booth's pressed steel roll rim bath tubs. 5x6½, paper.

Westinghouse Electric & Manufacturing Company, Pittsburg, Pa. Circular No. 1061 of Westinghouse automobile charging outfits. Illustrated by photographs and drawings. 7x10, pp. 23, paper.

Rockwell Engineering Company, 26 Cortlandt street, New York. Catalog D, describing and illustrating the Rockwell rotary melting furnace for copper, brass, bronze, aluminum, etc. 8x10, pp. 18, paper.

Queen & Co., Philadelphia, Pa. Pamphlet showing some views of the works of this company, some of its products, and commemorative of the fiftieth year of the existence of the business. 8x10½, pp. 16, paper.

Jas. Clark, Jr. & Co., Louisville, Ky. Booklet describing and illustrating some electrically driven tools made by this company, including "Willey" electrically driven grinders and breast drills. 3½x6, pp. 16, paper.

St. Louis (Mo.) Screw Company. Catalog and price list of screws, taps, bolts, nuts, washers, etc.; printed on coated paper, well illustrated by half-tone cuts and appended by a number of useful tables of weights. 6x9, pp. 71, paper.

We have received from Charles R. Pratt and Edward Van Winkle, consulting engineers, 160 Fifth avenue, New York, their Bulletin No. 1, which describes and illustrates the Pratt elevator safety. The pamphlet will be sent to anyone interested.

Miscellaneous Wants.

Advertisements will be inserted under this head at 25 cents a line each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Caliper cat. free. E. G. Smith, Columbia, Pa.

Punches & dies. Wal.M.Wks.,Waltham,Mass.

Wire and sheet metal working machinery and tools. Emmons Collins, Chicago.

Will buy or pay royalty for good patented machine or tool. Box 282, AMER. MACH.

Wanted—Patented specialties of merit. Address Power Specialty Co., Buffalo, N. Y.

Light and fine mach'y to order; models and elec. work specialty. E. O. Chase, Newark, N. J.

Automatic machinery designed and constructed by the Wellman Sole Cutting Machine Co., Medford, Mass.

Men wanted in every shop to sell Mechanics' Hand Soap. Eureka Mechanics' Hand Soap Co., 202 Maple st., Norwich, Conn.

An experienced engineer will perfect, simplify or improve upon articles of manufacture. Address Box 284, AMERICAN MACHINIST.

Wanted—Machinery or machine parts to build by contract or day work; good facilities; charges reasonable. Address A., care AMERICAN MACHINIST.

Wanted—Men to fill positions in shop and office; we always have openings; list your name where it will benefit you. Harrisburg Registry, Harrisburg, Pa.

Firm in Spain wants machinery for lead sanitary siphons; continuous pipe process; no casting in mold, in order to obtain a polished internal surface. Box 346, AM. M.

We desire an agent in every shop in the United States to handle our technical books; a wide-awake man can do very well; only one in a shop. The Derry-Collard Co., 256 Broadway, New York.

Well-known designer and shop manager wishes associates with capital to build a fully developed and highly successful machine tool; good profits, based on actual knowledge of costs—no guesswork—can be shown. Address Box 153, AMER. MACH.

Wanted—A practical manufacturing machinist, with from $1,000 to $10,000, to take an active interest in the manufacturing end of an established business; the object not capital, but brains and management in turning out the work. Address Box 258, AM. M.

Automobiles.—M. E., automobile specialist, man of brains, honest, energetic, having completed full designs and specifications of most modern car, offers machine tool builder start at once manufacturing automobiles; association basis; financial success guaranteed; open for thorough investigations. "Designer," care AMERICAN MACHINIST.

Wanted.—Have well-equipped, up-to-date machine shop specially fitted for manufacturing high-grade light machinery, electrical instruments, etc., and would like some first-class specialty to manufacture on contract; models built; inventions developed; gears cut; punches, dies and special tools made to order. Page Machine Co., No. 812 Greenwich st., corner Jane st., New York.

For Sale.

Motor cycle gasoline engine blueprints and castings for sale. L. T. Barnes, 75 Truxton st., Brooklyn, N. Y.

Small machine and brass works for sale in western Pennsylvania, now doing a good business. For particulars address R. J., care AMERICAN MACHINIST.

For Sale—Patent No. 749,544, granted Jan. 12, 1904, Ermo pipe wrench; this will bear investigation. Address W. H. Ermentrout, 514 Elm st., Reading, Pa.

"Crescent" reversible speed propellers for launches and sailing crafts; 2, 3 and 4 bladed; shop right for sale. Duluth Gas Engine Works, Duluth, Minn.

A stock of A1 gasoline engine castings, partly finished, stationary and marine, two-cycle, upright; cylinders 3½x3½, 4x4, 4½x4½; a bargain. Superior Gas Engine Works, Superior, Wis.

For Sale—Four complete sets of patterns with all drawings for large machine tools; will be pleased to correspond with parties wishing to take up a good line. Box 442, AMERICAN MACHINIST.

Manufacturing Plant for Sale.—We offer for sale, or lease if desired, the plant at the corner of 12th and French streets, which we are now vacating for our new works on the western city limits; equipped with power, cranes, tool foundations, shafting, hot air heating system, electric light plant, etc.; foundry in connection; suitable for medium or heavy manufacturing. Address Ball Engine Co., Erie, Pa.

An Investment Opportunity.—A limited number of shares of stock in a machinery manufacturing concern organized to absorb and to enlarge an old-established paying business, will for a short time be offered for sale.

This institution is unique, in that it will have no watered stock and will give away no stock for promotion. It is a safe, sound, paying proposition; best of references; write quick. Address P. O. Box 498, Stockton, Cal.

Wants.

Situation and Help Advertisements only inserted under this head. Rate 25 cents a line for each insertion. About six words make a line. No advertisements under two lines accepted, and no advertisements abbreviated. The cash and copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded; but replies will not be returned. If not forwarded they will be destroyed without notice. Original letters of recommendation or others papers of value should not be enclosed to unknown correspondents. Only bona-fide situation want or help want advertisements inserted under this heading. Agency advertisements must be placed under Miscellaneous Wants.

Situations Wanted.

Classification indicates present address of advertiser, nothing else.

CONNECTICUT.

Executive position wanted; age 38; a practical toolmaker; technical; 10 years in charge of finest manufacturing. Box 331, AMERICAN MACHINIST.

A native American mechanical engineer of education and experience desires correspondence with a view to a position as master mechanic, chief engineer or superintendent of power and plant. Address Box 328, AM. M.

ILLINOIS.

Machinery salesman, first class, desires to make a change; am practical machinist; can furnish unquestionable references and show successful record; would like to assume charge of sales department; prefer Eastern territory. Box 340, AMERICAN MACHINIST.

MARYLAND.

Experienced cost clerk, 10 years in the business, desires change. Box 360, AM. M.

MASSACHUSETTS.

Draftsman, long shop experience; designer jigs, fixtures, automatic machines. Box 357, AMERICAN MACHINIST.

Situation wanted as foundry foreman, by a man of large experience on all kinds of work; prefers large shop; good references. Box 316, AMERICAN MACHINIST.

An experienced man with good knowledge of tool making and designing, also up-to-date shop systems, desires position as assistant superintendent or foreman. Box 347, A. M.

NEW HAMPSHIRE.

Position as foreman or operator on automatic and hand screw machines; 8 years' experience. Box 341, AMERICAN MACHINIST.

NEW JERSEY.

A1 stationary engineer and machinist wants position; N. Y. or J. C. Box 294, A. M.

Technical graduate, 15 years' experience in responsible positions with well-known concerns engaged in medium and heavy machine work, desires connection in managing capacity. Box 353, AMERICAN MACHINIST.

NEW YORK.

Wanted—Position as foreman, machine shop or factory. Address F., care AM. M.

Mechanical-electrical draftsman desires a position. Box 350, AMERICAN MACHINIST.

Young man wishes position in toolroom. Bryman, 84 Gerry st., Brooklyn.

First-class mechanical draftsman wants to change position. Box 356, AMER. MACH.

Mechanical superintendent, good executive and business manager, desires change; A1 references. Box 354, AMER. MACHINIST.

Mechanical draftsman with 6 years' experience desires position; detail work preferred; practical shop experience. Box 355, AM. M.

Foreman, machinist, toolmaker, 12 years' experience at fine work, desires change; 4 years' experience as foreman. Address Box 344, AMERICAN MACHINIST.

General foreman, responsible man, 35, progressive, expert mechanic, experienced in interchangeable and special machinery, is open for engagement. Box 362, AM. MACH.

Mechanical engineer, familiar with refrigerating machinery, air compressors and gas engines, would like to represent some manufacturing concern in New York city. Address Box 348, AMERICAN MACHINIST.

OHIO.

Draftsman—Experienced, neat and resourceful. M., 417 E. Columbus st., Kenton, Ohio.

Wanted—Position of responsibility, by mechanical engineer, technical graduate, 8 years' office and shop experience, 2 years head draftsman; general machinery, machine tools, automatic and sheet-metal machines; A1 references. Box 349, AMERICAN MACHINIST.

Practical, experienced man of business and executive ability seeks position in charge of shop or drafting room; native American; expert on Corliss, pumping or blowing engines, special and labor-saving machinery and power stations. Box 359, AMER. MACHINIST.

WEST OF MISSISSIPPI.

Wanted—Position as M. E. or assistant M. E.; technical graduate; 6 years' shop and drafting-room experience; railway work, pressed steel and hydraulic presses. Box 351, AMERICAN MACHINIST.

Help Wanted.

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Wanted—First-class toolmakers; position permanent to suitable men. Ross Rifle Co., Quebec, Canada.

Wanted—First-class case-hardener; position permanent to the right man. Ross Rifle Co., Quebec, Canada.

Wanted—An assistant foreman for a machine shop producing light, interchangeable parts; must be thoroughly up-to-date, a hustler and a good handler of men; give references; position will pay $4 per day. P. O. Box 603, Guelph, Canada.

We are constantly increasing our plant, and invite applications from toolmakers, punch and die makers, lathe hands, screw machine operators, tinsmiths and specialty men, accustomed to light, small work; in making application state age, experience and where last employed. Petrie Mfg. Co., Limited, Guelph, Canada.

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Wanted—A first-class machinist for inspector on high-speed engine details. Address Box 338, AMERICAN MACHINIST.

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Wanted—An experienced editor for a technical magazine; one who has held a chair in Electrical, Mechanical or Civil Engineering, and in addition has had practical shop experience. Address, stating experience and salary expected. Box 339, AMER. MACH.

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Wanted—Machine shop foreman; principal product of factory is wood-working machinery; good pay to proper party; references required. Address Box 319, AMER. MACHINIST.

Wanted—Young man, general experience, as machinist; some knowledge of plain dies; work in small toolroom of wood-working plant; lathe, milling machine, etc.; desirable place; state everything in first letter. Box 578, Marion, Ind.

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Wanted—Mechanical draftsman; one on gasoline engine work preferred. Box 345, AMERICAN MACHINIST.

MASSACHUSETTS.

Wanted—A draftsman experienced on textile machinery. Box 320, AMER. MACHINIST.

Wanted—Mechanical draftsman with steam engine experience; state age, experience and salary expected. Apply Box 361, AM. M.

Wanted—An all-round turret machine man; one used to Cleveland automatic screw machine preferred. Address Boston Gear Works, Boston, Mass.

Wanted—A superintendent in a large gear jobbing shop; must be thoroughly experienced on gears; young man also wanted for office. Address "Gears," care AMER. MACHINIST.

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Wanted—A mechanical engineer; one who can take entire charge of several draftsmen and engineering department of a well-established company, manufacturing industrial cars and railway specialties of all descriptions; none but capable and experienced men need apply. "National," care AMER. MACH.

Automobile expert; must have mechanical and designing experience in up-to-date Autogas motor construction, and be able to produce neat and correct working drawings for shop use, and competent to take entire charge of drafting room in the department in our factory devoted to this line of work; a good position to a competent man; in answering, state experience and compensation expected. Address "Red Jacket," care A. M.

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Wanted—A draftsman, with shop experience, on special and automatic machinery and tools. Box 342, AMERICAN MACHINIST.

Wanted—An experienced machine shop foreman; up-to-date methods; day or piecework systems; engine work a specialty. Box 343, AMERICAN MACHINIST.

Wanted—A competent and experienced production clerk; one capable of supervising the production from machinery of a large manufacturing plant necessary and living near New York city preferred. Address S. Q., Box 315, AMERICAN MACHINIST.

Wanted—A competent foreman for an electrical manufacturing plant, employing fifty (50) hands, in central New York; applicants are requested to furnish references, state salary expected and date when they would be free to make an engagement. Address reply to "Electrical Machinist," care AM. MACH.

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Wanted—Man of experience to take position of master mechanic at a smelting plant in Colorado; must be thorough, practical machinist and well posted on steam and electrical equipment; salary $150 per month; state fully qualifications, experience, age and references. Address P. O. Box 1511, Denver, Colo.

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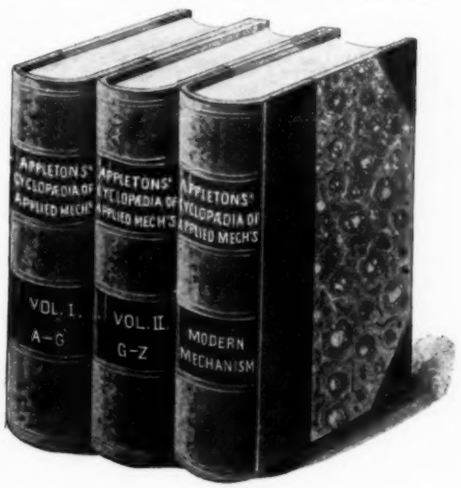

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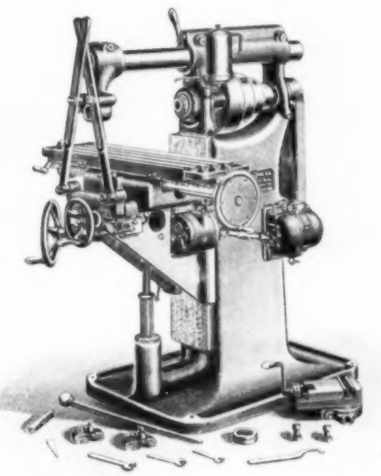

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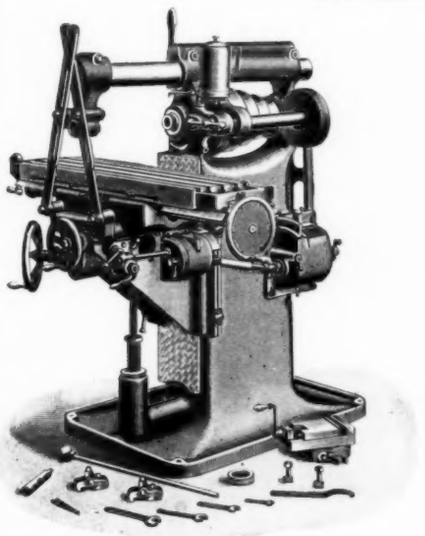

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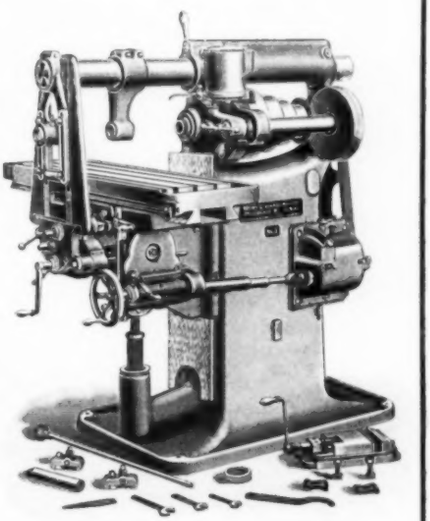

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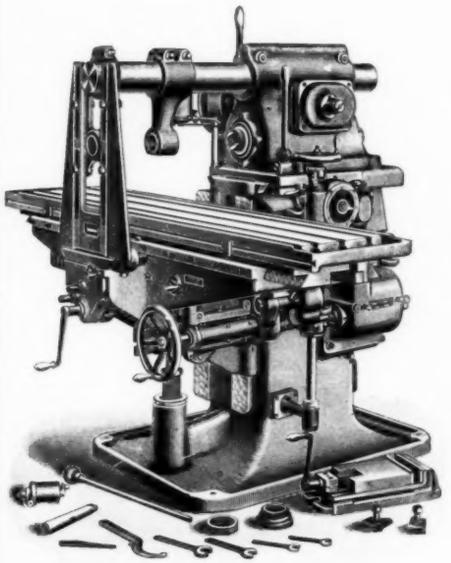

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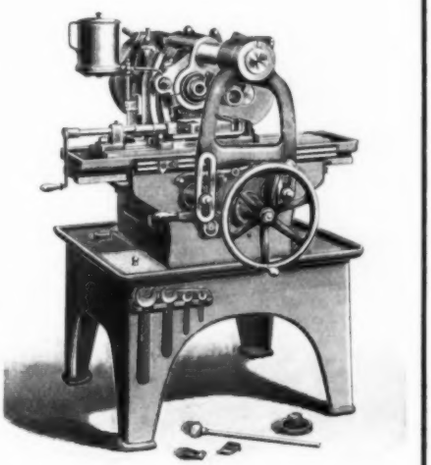

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Bending Machinery, Plate
Hilles & Jones Co., Wilmington, Del.
Niles-Bement-Pond Co., New York.
Perkins Mach. Co., So. Boston, Mass.
Wickes Bros., New York.

Bending Machines, Hydraulic
Niles-Bement-Pond Co., New York.
Watson-Stillman Co., New York.

Bending Machines, Power
Bethlehem Foundry & Mach. Co., So. Bethlehem, Pa.
Niles-Bement-Pond Co., New York.
Williams, White & Co., Moline, Ill.

Bending Tools, Hand
Estep & Dolan, Sandwich, Ill.
Wallace Supply Co., Chicago, Ill.

Blocks and Tackles
See Hoists, Hand.

Blowers
American Blower Co., Detroit, Mich.
Am. Gas Furnace Co., N. Y. City.
Buffalo Forge Co., Buffalo, N. Y.
Hartford Blower Co., Hartford, Conn.
Niles-Bement-Pond Co., New York.
Sturtevant Co., B. F., Boston, Mass.

Blue Print Machines
American Drafting Furniture Co., Rochester, N. Y.
Keuffel & Esser Co., New York.
Pittsburg Blue Print Co., Pittsburg, Pa.
Williams, Brown & Earle, Philadelphia, Pa.

Boilers
Struthers-Wells Co., Warren, Pa.
Wickes Bros., New York.

Blue Print Wringers
Keuffel & Esser Co., New York.
Pittsburg Blue Print Co., Pittsburg, Pa.
Williams, Brown & Earle, Philadelphia, Pa.

Bolt and Nut Machinery
Acme Mchry. Co., Cleveland, O.
Detrick & Harvey Mach. Co., Baltimore, Md.
Howard Iron Wks., Buffalo, N. Y.
Niles-Bement-Pond Co., New York.
Reliance Mach. & Tool Co., Cleveland, O.
Standard Engineering Co., Elwood City, Pa.
Webster & Perks Tool Co., Springfield, O.
Wiley & Russell Mfg. Co., Greenfield, Mass.
Waterbury Farrel Fdry. & Mach. Co., Waterbury, Conn.
Williams Tool Co., Erie, Pa.

Bone for Case-Hardening
Rogers & Hubbard Co., Middletown, Conn.

Books, Mechanical
Audel & Co., Theo., New York.
Baird & Co., Henry Carey, Philadelphia, Pa.
Derry-Collard Co., New York.
Gas Engine Pub. Co., Cincinnati, Ohio.
Henley Pub. Co., The Norman W., New York.
Van Nostrand Co., D., New York.
Wiley & Sons, John, New York.

Boring and Drilling Machines, Horizontal
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Beaman & Smith Co., Provi., R. I.
Betts Mach. Co., Wilmington, Del.
Binsse Mach. Co., Newark, N. J.
Boynton & Plummer, Worcester, Mass.
Dallett Co., Thos. H., Phila., Pa.
Detrick & Harvey Mach. Co., Baltimore, Md.
Fosdick Mach. Tool Co., Cin., O.
Hill, Clarke & Co., Boston, Mass.
Lucas Mach. Tool Co., Cleve., O.
McCabe, J. J., New York.
Meadville Vise Co., Meadville, Pa.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Pawling & Harnischfeger, Milwaukee, Wis.
Prentiss Tool & Supply Co., New York.
Warner & Swasey Co., Cleveland, Ohio.

Boring and Turning Mills
American Tool Wks. Co., Cin., O.
Baush Mach. Tool Co., Springfield, Mass.
Bertram & Sons Co., Ltd., John, Dundas, Ont., Canada.
Betts Mach. Co., Wilmington, Del.
Bickford & Co., H., Lakeport, N. H.
Bullard Mach. Tool Co., Bridgeport, Conn.
Colburn Mch. Tool Co., Franklin, Pa.
Hill, Clarke & Co., Boston, Mass.
King Mach. Tool Co., Cincin., O.
McCabe, J. J., New York.
Niles-Bement-Pond Co., New York.
Poole Co., J. Morton, Wilmington, Del.
Prentiss Tool & Supply Co., New York.
Warner & Swasey Co., Cleveland, Ohio.

Boxes, Tote
Lyon Metallic Mfg. Co., Chicago, Ill.

Brazing Material
Goldschmidt Thermit Co., New York.

Bulldozers
Williams, White & Co., Moline, Ill.

Cabinets, Oil
Bowser Co., S. F., Fort Wayne, Ind.

Carbon Paper
Hano & Co., Philip, New York.

Carborundum
See Grinding Wheels.

Castings, Brass
Phosphor Bronze Smelting Co., Philadelphia, Pa.
Nolte Brass Co., Springfield, O.

Case-Hardening
Rogers & Hubbard Co., Middletown, Conn.

Castings, Die Molded
Franklin Mfg. Co., Syracuse, N. Y.

Castings, Iron
Farrel Foundry & Mach. Co., Ansonia, Conn.

Castings, Motor
Harrison, H. K., St. Paul, Minn.
Steffey Mfg. Co., Philadel., Pa.

Castings, Steel
Cooper-Wigand-Cooke Co., New York.
Diamond Drill & Mach. Co., Birdsboro, Pa.
Farrel Foundry & Mach. Co., Ansonia, Conn.

Centering Machines
Phoenix Mfg. Co., Hartford, Conn.
Pratt & Whitney Co., Hartford, Conn.
Whiton Machine Co., D. E., New London, Conn.

Centers, Planer
Fay & Scott, Dexter, Me.
New Haven Mfg. Co., New Haven, Conn.
Pratt & Whitney Co., Hartford, Conn.
Reed Co., F. E., Worcester, Mass.

Chains, Driving
Boston Gear Works, Boston, Mass.
Bridgeport Chain Co., Bridgeport, Conn.
Federal Mfg. Co., Cleveland, O.
Jeffrey Mfg. Co., The, Columbus, Ohio.
Link Belt Engr. Co., Phila., Pa.
Morse Chain Co., Trumansburg, N. Y.
Oneida Community, Kenwood, N. Y.
Whitney Mfg. Co., Hartford, Ct.

Chucking Machines
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Automatic Mach. Co., Cleveland, O.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Reed Co., F. E., Worcester, Mass.
Warner & Swasey Co., Cleveland, Ohio.
Windsor Mach. Co., Windsor, Vt.

Chucks, Drill
Almond, T. R., Brooklyn, N. Y.
Brown & Co., R. H., New Haven, Conn.
Cleveland Twist Drill Co., Cleveland, O.
Cushman Chuck Co., Hartford, Ct.
Detroit Twist Drill Co., Detroit, Mich.
Goodell-Pratt Co., Greenfield, Mass.
The E. Horton & Son Co., Windsor Locks, Conn.
Jacobs Mfg. Co., Hartford, Conn.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Niles-Bement-Pond Co., New York.
Pratt Chuck Co., Frankfort, N. Y.
Standard Tool Co., Cleveland, O.
Trump Bros. Mach. Co., Wilmington, Del.
Whitney Mfg. Co., Hartford, Ct.
Whiton Mach. Co., D. E., New London, Conn.

Chucks, Lathe
Cushman Chuck Co., Hartford, Ct.
Hoggson & Pettis Mfg. Co., New Haven, Conn.
The E. Horton & Son Co., Windsor Locks, Conn.
Niles-Bement-Pond Co., New York.
Skinner Chuck Co., New Britain, Conn.
Westcott Chuck Co., Oneida, N. Y.
Whiton Mach. Co., D. E., New London, Conn.

Chucks, Magnetic
Walker & Co., O. S., Worcester, Mass.

Chucks, Planer
Niles-Bement-Pond Co., New York.

Chucks, Split
Faneuil Watch Tool Co., Boston, Mass.
Hardinge Bros., Chicago, Ill.

Clutches, Friction
Caldwell, Son & Co., H. W., Chicago, Ill.
Carlyle Johnson Mach. Co., Hartford, Conn.
Cresson Co., Geo. V., Phila., Pa.
Faneuil Watch Tool Co., Boston, Mass.
Niles-Bement-Pond Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Smith, F. L., Franklin Falls, N. H.

Clutches, Magnetic and Electrical
Electric Controller & Supply Co., Cleveland, O.

Compound, Boiler
Harris Oil Co., A. W., Provi., R. I.

Compound, Pipe Joint
Dixon Crucible Co., Jos., Jersey City, N. J.

Compressors, Air
Blaisdell Machinery Co., Bradford, Pa.
Blanchard Mach. Co., Boston, Mass.
Christensen, N. A., Milwaukee, Wis.
Clayton Air Compressor Works, New York.
Curtis & Co. Mfg. Co., St. Louis, Mo.
General Pneumatic Tool Co., Montour Falls, N. Y.
Herron & Bury Mfg. Co., Erie, Pa.
Ingersoll-Sergeant Drill Co., New York.
Rand Drill Co., New York.

Connecting Rods and Straps
Heppenstall Forge & Knife Co., Pittsburg, Pa.
Standard Connecting Rod Co., Beaver Falls, Pa.

Controllers and Starters, Electric Motor
Electric Controller & Supply Co., Cleveland, O.
General Electric Co., New York.

Coping Machines
Long & Allstatter Co., Hamilton, Ohio.
Niles-Bement-Pond Co., New York.

Correspondence Schools
See Schools, Correspondence.

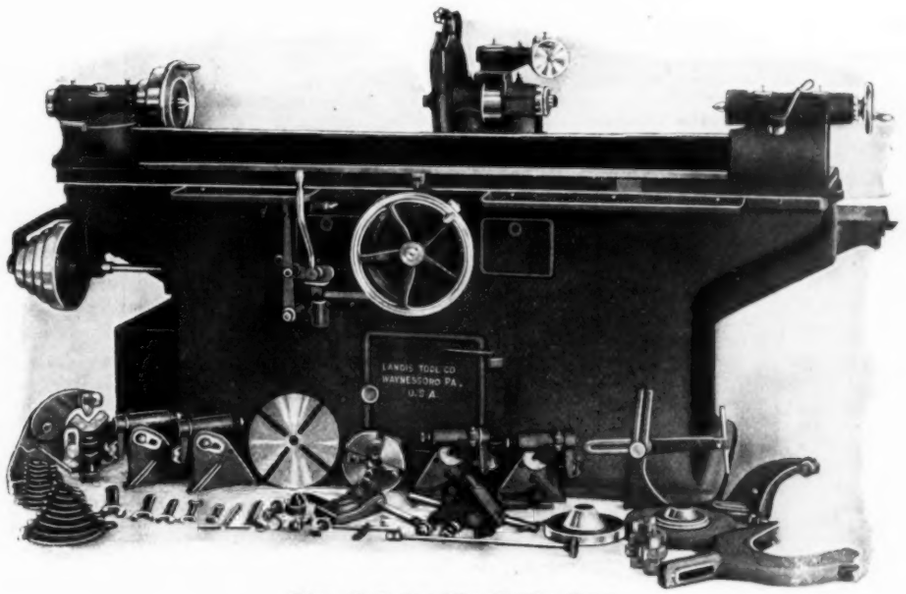
Counterbores
Slocomb Co., J. T., Provi., R. I.

Countershafts
Builders' Iron Fdry. Provi., R. I.
National Machine Tool Co., Cincinnati, O.
Wilmarth & Morman Co., Grand Rapids, Mich.

Counting and Printing Wheels
Franklin Mfg. Co., Syracuse, N. Y.

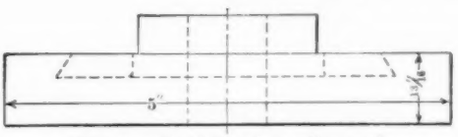
Couplings, Shaft
Caldwell & Son Co., H. W., Chicago, Ill.
Cresson Co., Geo. V., Philadel., Pa.
Davis Mach. Co., W. P., Rochester, N. Y.
Niles-Bement-Pond Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Stuart, R. J., New Hamburg, N. Y.
Vandegrift Coupling Co., Evansville, Ind.

Cranes
Brown Hoisting Mach. Co., New York.
Case Mfg. Co., Columbus, O.
Chambersburg Engineering Co., Chambersburg, Pa.
Cleveland Crane & Car Co., Wickliffe, O.
Curtis & Co. Mfg. Co., St. Louis, Mo.



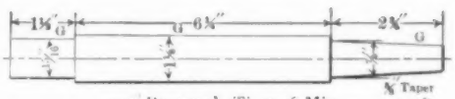
No. 4 Landis Grinder

And a couple of things done thereon.



Cast Iron Hand Wheel. .010 Removed from Face and Side in 6 Min.

No. 3 Mach.



.005 Removed. Time:-6 Min. Accuracy Limit:-.0025"

Landis Grinders

One feature of the Landis Grinder deserves your especial attention. That is the provision for a generous supply of fresh, clear water. Grinding should be kept cool and clean, fresh water is the thing to keep it cool. Clean water means faster cutting and longer life to the wheel, because clean water does not gum and fill the wheel, necessitating its refacing. The water is so contained in the Landis that there is no slop or dirt. This generous use of water obtaining with the Landis is quite a factor in the production of accurate work, because no strains are set up on account of the heating of any one portion of the work while the remainder is cool. The Landis keeps the whole piece of work at an even, cool temperature, so that things ground cylindrical are absolutely round and flat surfaces are flat. You will do well to make a thorough investigation of Landis features, and we shall be pleased to aid you in any way you may elect.

Landis Tool Co., Waynesboro, Pa., U. S. A.

AGENTS:—Walter H. Foster, Manager, New York and Boston. Brown & Zortman Machinery Co., Pittsburgh. Marshall & Huschurt Machinery Co., Cleveland. C. W. Burton, Griffiths & Co., London. Schuchardt & Schutte, Berlin, Cologne, Vienna, Brussels, Stockholm, St. Petersburg, Liege, Milano, Paris and Bilbao. A. R. Williams Machinery Co., Toronto. Williams & Wilson, Montreal, Canada.

Cranes —*Continued*
General Pneumatic Tool Co., Montour Falls, N. Y.
Lane Mfg. Co., Montpelier, Vt.
Maris Bros., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Northern Engineering Works, Detroit, Mich.
Obermayer Co., S., Cincinnati, O.
Pawling & Harnischfeger, Milwaukee, Wis.
Sellers & Co., Wm., Philadel., Pa.

Crank Pin Turning Machine
Niles-Bement-Pond Co., New York.
Underwood & Co., H. B., Philadelphia, Pa.

Crank Shafts
Heppenstall Forge & Knife Co., Pittsburg, Pa.
Standard Connecting Rod Co., Beaver Falls, Pa.

Crucibles
Dixon Crucible Co., Jos., Jersey City, N. J.
Obermayer Co., S., Cincinnati, O.

Cupolas, and Ladles, Foundry
Byram & Co., Detroit, Mich.
Northern Engr. Works, Detroit, Mich.
Obermayer Co., S., Cincinnati, O.
Paxson Co., J. W., Philadel., Pa.
Stevens, F. B., Detroit, Mich.

Cut Meters
Warner Instrument Co., Beloit, Wis.

Cutters, Milling
Adams Co., Dubuque, Iowa.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Etna Mfg. Co., New York.
Gay & Ward, Inc., Athol, Mass.
Ingersoll Milling Mach. Co., Rockford, Ill.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Standard Tool Co., Cleveland, O.
Whitney Mfg. Co., Hartford, Ct.

Cutting-off Machines
Bignall & Keeler Mfg. Co., Edwardsville, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
Davis Mach. Co., W. P., Rochester, N. Y.
Huribut-Rogers Mach. Co., South Sudbury, Mass.
Newton Mach. Tool Wks., Philadelphia, Pa.
Nutter, Barnes & Co., Boston, Mass.
Pratt & Whitney Co., Hartford, Conn.

Cutting-off Tools
Armtrong Bros. Tool Co., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Fairbanks Machine Tool Co., Springfield, O.
Goodell Mfg. Co., Greenfield, Mass.
O. K. Tool Holder Co., Shelton, Conn.
Pratt & Whitney Co., Hartford, Conn.
Toronto Mch. Co., Toronto, Ohio.
Western Mfg. Co., Springfield, O.

Diamond Tools
Dickinson, Thos. L., New York.
Steel Set Diamond Co., New York.

Dies, Sheet Metal
Bliss Co., E. W., Brooklyn, N. Y.
Consolidated Press & Tool Co., Chicago, Ill.
Delivouk & George, Chicago, Ill.
Globe Mach. & Stamping Co., Cleveland, O.
Hay-Budden Mfg. Co., Brooklyn, N. Y.
Perkins Mach. Co., So. Boston, Mass.

Dies, Threading, Opening
Errington, F. A., New York.
Geometric Drill Co., New Haven, Conn.
Ideal Opening Die Co., New York.

Dies, Threading, Opening *Continued*
Jones & Lamson Mch. Co., Springfield, Vt.
Modern Tool Co., Erie, Pa.
Pratt & Whitney Co., Hartford, Conn.

Dowel Pins
Obermayer Co., S., Cincinnati, O.
Winkley Co., Hartford, Conn.

Drafting Machines
Universal Drafting Mach. Co., Cleveland, O.

Drawing Boards and Tables
Alexander Mfg. Co., J. G., Grand Rapids, Mich.
American Drafting Furniture Co., Rochester, N. Y.
Keuffel & Esser Co., New York.
Rich, J. & G., Philadelphia, Pa.

Drawing Instruments
Alteneder & Sons, Theo., Philadelphia, Pa.
Keuffel & Esser Co., New York.

Drilling Machines, Bench
Barnes Co., W. F. & John, Rockford, Ill.
Boynton & Plummer, Worcester, Mass.
Pratt & Whitney Co., Hartford, Conn.
Sloan & Chace Mfg. Co., Newark, N. J.

Drilling Machines, Boiler
American Tool Wks. Co., Cin., O.
Bickford Drill & Tool Co., Cincinnati, O.
Boynton & Plummer, Worcester, Mass.
Dallett Co., Thos. H., Phila., Pa.
Niles-Bement-Pond Co., New York.

Drilling Machines, Multiple Spindle
American Tool Wks. Co., Cin., O.
Baker Bros., Toledo, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Baush Mach. Tool Co., Springfield, Mass.
Bickford Drill & Tool Co., Cincinnati, O.
Dallett Co., Thos. H., Phila., Pa.
Fenn-Sadler Machine Co., Hartford, Conn.
Garvin Mach. Co., New York.
Hardinge Bros., Chicago, Ill.
Flather Planer Co., Mark, Nashua, N. H.
Fosdick Mach. Tool Co., Cin., O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
McCabe, J. J., New York.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Newton Machine Tool Works, Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.

Drilling Machines, Pneumatic
Cleveland Pneu. Tool Co., Cleveland, O.
Ingersoll-Sergeant Drill Co., New York.
Niles-Bement-Pond Co., New York.
Phila. Pneumatic Tool Co., Philadelphia, Pa.
Rand Drill Co., New York.

Drilling Machines, Portable
Coates Clipper Mfg. Co., Worcester, Mass.
Dallett Co., Thos. H., Phila., Pa.
Hisey-Wolf Mch. Co., Cincin., O.
Niles-Bement-Pond Co., New York.

Drilling Machines, Radial
American Tool Wks. Co., Cin., O.
Baush Mach. Tool Co., Springfield, Mass.
Bickford Drill & Tool Co., Cincinnati, O.
Dreses Mach. Tool Co., Cincin., O.
Fosdick Mach. Tool Co., Cin., O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hill, Clarke & Co., Boston, Mass.
McCabe, J. J., New York.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Mueller Mach. Tool Co., Cin., O.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Vandyck Co., J. R., New York.

Drilling Machines, Turret
Niles-Bement-Pond Co., New York.
Quint, A. D., Hartford, Conn.

Drilling Machines, Upright
American Tool Wks. Co., Cin., O.
Baker Bros., Toledo, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Bertram & Sons Co., Ltd., John, Dundas, Ont., Canada.
Blaisdell & Co., P., Worcester, Mass.
Boynton & Plummer, Worcester, Mass.
Cincinnati Mach. Tool Co., Cin., O.
Dallett Co., Thos. H., Phila., Pa.
Davis Mach. Co., W. P., Rochester, N. Y.
Fosdick Mach. Tool Co., Cincinnati, O.
Gould & Eberhardt, Newark, N. J.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hill, Clarke & Co., Boston, Mass.
Hoefer Mfg. Co., Freeport, Ill.
Knecht Bros. Co., Cincinnati, O.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
McCabe, J. J., New York.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Mechanics Machine Co., Rockford, Ill.
Niles-Bement-Pond Co., New York.
New Haven Mfg. Co., New Haven, Conn.
Prentiss Tool & Supply Co., New York.
Sibley & Ware, South Bend, Ind.
Sloan & Chace Mfg. Co., Newark, N. J.
Vandyck Co., J. R., New York.
Washburn Shops, Worcester, Mass.
Whitney Mfg. Co., Hartford, Conn.

Drills, Center
Pratt & Whitney Co., Hartford, Conn.
Slocomb Co., J. T., Providence, R. I.

Drills, Hand
Dallett Co., Thos. H., Phila., Pa.
Hisey-Wolf Mach. Co., Cincin., O.
Niles-Bement-Pond Co., New York.

Drills, Rail
Niles-Bement-Pond Co., New York.

Drills, Ratchet
Greene, Tweed & Co., New York.
Parker Co., Chas., Meriden, Conn.
Pratt & Whitney Co., Hartford, Conn.

Dynamos
Bullock Elec. Mfg. Co., Cincin., O.
C & C Electric Co., New York.
Commercial Electric Co., Indianapolis, Ind.
Crocker-Wheeler Electric Co., Ampere, N. J.
Emerson Electric Mfg. Co., St. Louis, Mo.
General Elec. Co., New York.
Jantz & Leist Elec. Co., Cin., O.
Keystone Electric Co., Erie, Pa.
Northern Elec. Mfg. Co., Madison, Wis.
Robbins & Myers Co., Springfield, Ohio.
Roth Bros. & Co., Chicago, Ill.
Sprague Elec. Co., New York.
Triumph Elec. Co., Cincinnati, O.
Western Electric Co., Chicago, Ill.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

Electrical Supplies
Bullock Elec. Mfg. Co., Cincin., O.
Commercial Electric Co., Indianapolis, Ind.
Emerson Electric Mfg. Co., St. Louis, Mo.
General Elec. Co., New York.
Keystone Electric Co., Erie, Pa.
Roth Bros. & Co., Chicago, Ill.
Triumph Elec. Co., Cincinnati, O.
Western Electric Co., Chicago, Ill.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

Electrically Driven Tools
Hisey-Wolf Mach. Co., Cincin., O.

Elevators
Albro-Clem Elevator Co., Philadelphia, Pa.
Curtis & Co. Mfg. Co., St. Louis, Mo.
Howard Iron Wks., Bualo, N. Y.
Morse, Williams & Co., Phila., Pa.

Emery Wheel Dresser
Desmond-Stephan Mfg. Co., Urbana, O.
Dickinson, Thos. L., New York.

Emery Wheels
See Grinding Wheels.

Enclosures, Tool-room
Merritt & Co., Philadelphia, Pa.

Engineer, Consulting and Mechanical
Hollingsworth, Samuel, Plainfield, N. J.
McGeorge & Sons, Cleveland, O.

Engines, Automobile
Olds Motor Works, Lansing, Mich.

Engines, Gas and Gasoline
Backus Water Motor Co., Newark, N. J.
Foos Gas Eng. Co., Springfield, O.
Mietz, August, New York.
New Era Gas Engine Co., Dayton, Ohio.
Olds Motor Wks., Lansing, Mich.
Regal Gasoline Engine Co., Coldwater, Mich.
Struthers-Wells Co., Warren, Pa.

Engines, Steam
American Blower Co., Detroit, Mich.
Buffalo Forge Co., Buffalo, N. Y.
Frick Co., Waynesboro, Pa.
Rand Drill Co., New York.
Struthers-Wells Co., Warren, Pa.
Sturtevant Co., B. F, Boston, Mass.

Engraving Machinery
Gorton Mach. Co., Geo., Racine, Wis.
Roovers Mfg. Co., New York.

Exhaust Heads
American Blower Co., Detroit, Mich.
Burt Mfg. Co., Akron, O.

Exhibition, Machinery
Philadelphia Bourse, Phila., Pa.

Export, Russian
Gradstone & Co., M., New York.

Fans, Exhaust
Sturtevant Co., B. F., Boston, Mass.

Fans, Electric
Emerson Electric Mfg. Co., St. Louis, Mo.
General Electric Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.
Sprague Elec. Co., New York.
Western Electric Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Files and Rasps
Barnett Co., G. & H., Phila., Pa.
Etna Mfg. Co., New York.
Hammacher, Schlemmer & Co., New York.
Nicholson File Co., Provi., R. I.

Filing Machines
Cochrane-Bly Mach. Co., Rochester, N. Y.
Kinsey-Burt Co., New York.

Fillers, Oil Can
The Winkley Co., Hartford, Conn.

Fillets, Leather
Canton Fillet Co., Canton, O.

Filters, Oil
Burt Mfg. Co., Akron, O.

Flexible Shafts
Chicago Flexible Shaft Co., Chicago, Ill.
Coates Clipper Mfg. Co., Worcester, Mass.
Stow Mfg. Co., Binghamton, N. Y.

Forges
Boynton & Plummer, Worcester, Mass.
Buffalo Forge Co., Buffalo, N. Y.
Miner & Peck Mfg. Co., New Haven, Conn.
Sturtevant Co., B. F., Boston, Mass.

Forgings, Drop
Billings & Spencer Co., Hartford, Conn.
Clapp Mfg. Co., E. D., Auburn, N. Y.
Williams & Co., J. H., Brooklyn, N. Y.
Wyman & Gordon, Worcester, Mass.

Forgings, Steel
Hay-Budden Mfg. Co., Brooklyn, N. Y.
Wyman & Gordon, Worcester, Mass.

Lathe Spindle Design.

BY JOHN RANDOL.

Bloss built his lathe, as described in the preceding paper, with a taper spindle bearing and a screw center at the rear, probably because he had seen a watchmaker's Swiss lathe so constructed, and for a long time all watch-tool makers supposed that a small machine-tool spindle must have taper bearings to do good work. When the first watch-factory tools were made nothing but taper bearings were used, and they have not yet disappeared, though there are now many fine tools made with cylindrical spindles.

The Sloan & Chace "regular" No. 5 lathe spindle, shown in Fig. 2, with dimensions, may be taken as a good example of approved cone tool-spindle practice. The spindle itself is made from a round blank cut from round bars of 35 carbon steel, 1½ inches diameter. The cones and drawback sleeves are made of the same 35-point steel and the beds and headstocks and tailstocks are of gray iron. The cone spindle boxes are cylindrical outside, and are the same diameter front and rear, so that after the headstocks and tailstocks are fitted to the bed-ways the hight and alinement of the head and tail spindles can be produced in practically perfect duplication by boring the box seats and tail-spindle seats in a standard fixture which takes the largest size, and is also made to take all smaller sizes of headstocks and tailstocks by placing "adapters" on the ways of the original large fixture.

The "adapter" is the instrument which makes small tool interchangeability of parts, as headstocks and tailstocks and so on, possible between different machines of different sizes. It consists of a base fitted on the bottom to the bed-ways of the largest machine of the series, and having on its top an exact reproduction of the bed-ways of a smaller machine. By placing adapters in the headstock and tailstock boring fixture it is evident that the one boring fixture can be used to bore all sizes of headstocks and tailstocks, and that if the boring-bar axis is once located exactly in the middle over the bed-ways and also exactly parallel to the bed-ways of the boring fixture, then all headstocks and tailstocks bored on this fixture will retain their alinement when reversed on the ways, and also that, since there is no perceptible wear on the boring fixture in work, practically perfect duplications of head and tail spindle locations will be made, so long as the original boring fixture is in existence.

If the spindle is not carried on cone bearings but is made cylindrical in form, then the headstock box seats must be bored in conical form, and this makes the boring of the headstock a much more complex operation. Examples of both straight and conical spindle bearings will be shown, and it is to be noted that the cylindrical spindle has very great advantages in some directions over the cone bearing spindles.

The object of the cone bearing is to enable wear to be accurately taken up without change of spindle position. If the spindle wear in the box is exactly the same all around, top, sides and bottom of the box being all equally enlarged by wear, then the taper box can be shoved endwise in its cylindrical seat in the headstock, so as to take up the lost motion of the spindle absolutely without any change of spindle axis location. If, however, the cone box is worn more on one side than on the other, then moving the box endwise on the spindle may slightly change the spindle axis. So far as I know, no lathe spindle is so supported as to make it certain that box wear cannot in any degree affect the spindle axis location. In practice, however, the spindles here under discussion are so very large for the work they have to do that there is seldom any trouble caused by wear.

Referring to Fig. 2, Sloan & Chace No. 5 lathe spindle, the largest of their "regular" bench lathes, *A* is the flange to which the hard rubber drawback hand-wheel is secured by screws. This flange is slipped to a shoulder on the drawback sleeve *B*, and secured endwise by expanding the outer end of the soft sleeve and held against turning by the pin A^1. *B* has a front shoulder at B^2 abutting against the rear end of the spindle and has a lapped ½-inch hole straight through it. The front end of the sleeve extends forward inside the spindle, in which the sleeve turns freely, and is internally threaded at its front end, B^3, to take the rear collet ends which are ground to a sliding fit in the hardened front end of the spindle ground in two angles, that at the mouth, which closes the split collet jaws on the work when the collet is drawn in by the sleeve thread, having a 20-degree angle. The other 4-degree angle is a clearance. The spindle is hardened back beyond the front bearing of the sleeve, and ground. The sleeve is made to fit the rear end of the spindle so that the hand-wheel will run true, but is free in the lathe spindle most of its length.

It is the drawback sleeve and threaded collet, having its jaws closed by the coned spindle mouth, giving a means of chucking work in the collet jaws truly, that enables the machine-made watch to be pro-

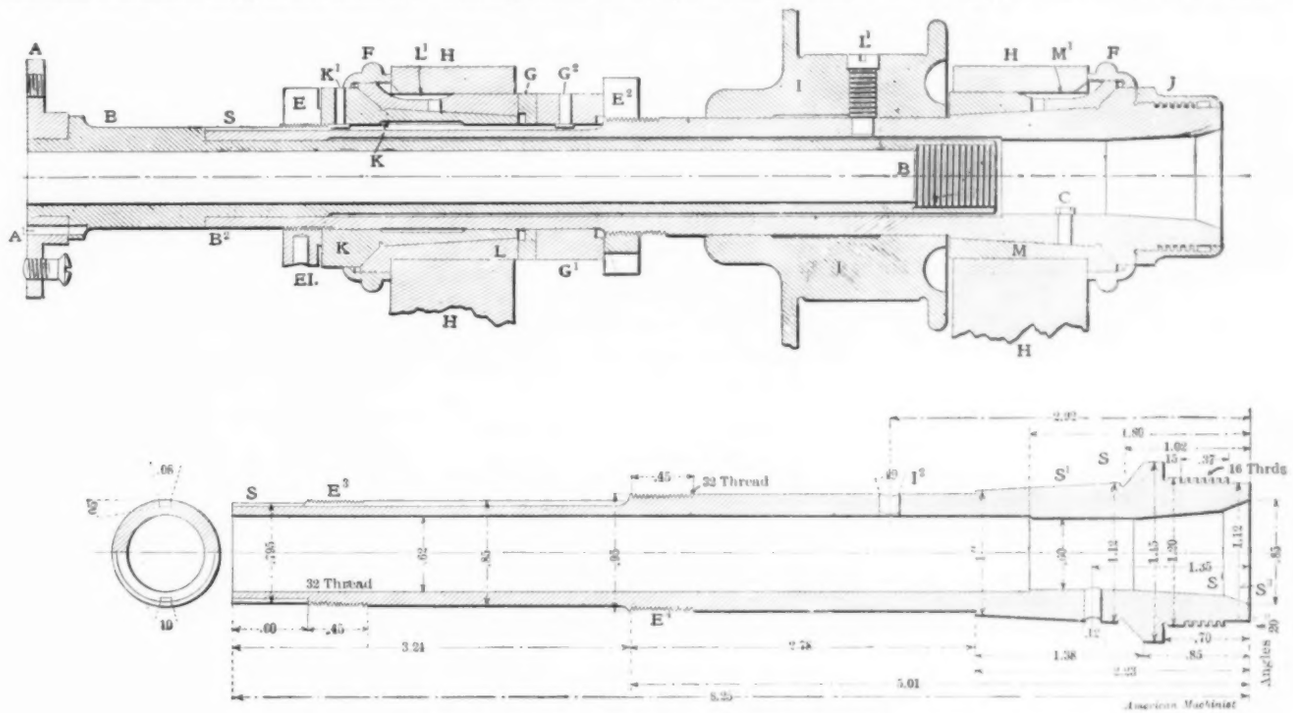


FIG. 2. SLOAN & CHACE NO. 5 LATHE SPINDLE.

duced, and the spring collet must be used with a hollow lathe spindle. This combination of the hollow lathe spindle, the hollow drawback sleeve and the cone-jawed collet, appears constantly in small tool construction, and though as yet very little used in ordinary machine shops, has a great field there which it must very soon occupy.

This is the simplest form of collet-operating mechanism, and has the one fault of moving the rod grasped in the collet jaws a very little to the rear, as the jaws close by being drawn backward. For most purposes this is no objection, but in a few cases it must be avoided, and is cured by moving the internal cone, which closes the collet jaws, forward, the collet having no end movement at all. This makes a much more complicated spindle, and when a rod feed, consisting of spring jaws which slide inside the sleeve, is added, the spindle becomes a decidedly complex affair.

In Fig. 2, detail section of the No. 5 lathe spindle, the front spindle cone, integral with the spindle, is seen to be composed of two cones, one of 3-degree angle, marked S^1, and one of 45 degrees, marked S^2. These angles are chosen as coming near to satisfying the conditions of wear. The spindle has side-thrusts from its work and end-thrusts also. It wears more rapidly at its front end than anywhere else, and also has more surface to resist wear in front than anywhere else, as it should have. The 45-degree cone resists light rearward thrusts very well, but heavy pushing back is liable to injure the bearing, and to help out in this particular a vulcanized fiber washer G is placed on the spindle between the front end of the rear box K and the rear face of a sliding collar G^1, splined to the spindle, and adjusted by the split nut E^2 threaded on the spindle, 32 per inch. This nut is split on one side, and is closed and then hardened and tempered, so as to move stiffly on its thread to adjust the fiber washer. G^2 is a stud fitted to its spindle spline to prevent G^1 from turning, and this device of a split, closed and tempered spring-nut and splined collar is very much used in small machine tools. It appears again at E where it is threaded on the spindle to adjust the cone K, having a stud K^1 sliding in the spindle spline K^2. K is the same shape as the front spindle journal S^1, S^2 3-degree and 45-degree angles, reversed.

The headstock H is bored the same diameter in both uprights, and lapped smooth, to take hard bushes, ground about a thousandth of an inch larger than the headstock box seat diameter, and forced in place, where they are retained by friction only. This does not seem enough to secure the box against a heavy end thrust on the spindle; but no box has ever been known to yield to end-thrust, hence this forcing and friction holding of the box in place appears sufficient. It would be difficult to secure the box in the headstock by anything in the way of a pin or screw without danger of placing an initial side-thrust on the box, and probably the friction retention is the best available.

The mill-cuts L^1, M^1, are not now made in the core-box; they were used as oil leads; the dust covers F, F^1, were stripped away to give access to the oil groove. The oiling is now by small brass oil cups, screw capped, screwed into the tops of the headstock uprights.

It will be noted that E and E^2 oppose each other in action, and must be adjusted with some care, and that the functions of S^2 and G are identical, both resisting rearward spindle thrusts, also that G and S^2 are independently adjustable and that there is no certainty as to whether G or S^2 shall actually resist the rearward spindle thrust. This functional imperfection is caused by the inability of the 45-degree angle cone S^2 to endure very heavy rearward thrusts.

The belt cone I has three steps for a 1-inch flat belt, and is held to the spindle by the round tit on the end of I^1, screwed into the pulley.

The spindle is threaded at E^3 and E^4 to take adjusting nuts, and is provided with an internal stud C engaging the collet spline to keep it from turning.

Rights of Foreign Creditors in Bankruptcy Cases.

United States Consul Monaghan sends from Chemnitz, Germany, interesting information and advice, a portion of which we reproduce for Americans who may have bankrupt debtors in foreign countries.

FRANCE.

The laws of France do not require that foreign creditors shall be represented before the courts by an attorney. This procedure is not alone superfluous, but also dangerous, for the attorney's fees are not regulated by law when dealing with foreign creditors and can be very much in excess of that prescribed by the French law. It is customary and advisable, in a case of bankruptcy, to appoint a local executor. These officials look after the interests of foreign creditors with a great deal of care, and, as a rule, obtain very good results. The usual procedure is for the foreign creditor to receive an official notification of the failure from an executor wherein he offers his services. If one has no regular representative at the place of failure, it is wise for him to accept the executor's offer and sign the power of attorney which he always incloses.

RUSSIA.

The laws of Russia pertaining to bankruptcy are very severe. A merchant in Russia can be declared bankrupt if his liabilities exceed 1,500 rubles ($772.50) and he has not the ready cash to meet the same. He can be arrested and his retention depends on the good will of his creditors. A creditor who enters claim against a bankrupt must deposit 75 rubles ($38.63) for the cost of court. All foreign creditors must make claim within twelve months after date of failure, otherwise their claims are void. In Russia the court publishes the fact of the bankruptcy, but gives no official notification to the creditors; for this reason foreign creditors know nothing of the existing conditions until it is too late. For the above reasons it would be wise for exporters to keep a watchful eye on their oustanding debts in Russia.

ITALY.

In Italy creditors have the right to demand 6 per cent. interest on all debts not paid when due. Regularly accepted drafts which are not honored at expiration can at once go to protest, but must pass through a notary's hands. The court executor can perform this duty, but the law demands several days' grace before the belongings of the debtor can be sold. All business men in Italy are compelled to keep two account books, and each and every transaction must be entered in each of these books. When a page is full a government official comes and examines the same and, if he finds it in order, stamps, numbers and signs it. In case a merchant is pressed for payment by a creditor and he can prove by his account books that his resources are greater than his liabilities, the court will grant the merchant six months' time to settle up with his creditors. During these six months his business is watched over by an official from the court and a representative of the creditor or creditors. In the case of bankruptcy, creditors must send in their claims to the official who has charge of the case. All claims of foreign creditors must be attested to in order to show correctness of the creditor's demands.

TURKEY.

All cases of debt between Turks and foreigners are dealt with in the local courts. In such cases a consulate's dragoman is present to protect the interests of the foreign creditor and to see to it that the court proceedings are in keeping with the law. In Smyrna foreign creditors have a still greater protection: for, apart from the dragoman, there are two other consular representatives at the court. In case plaintiff and defendant are of different nationalities, the court is held at the consulate of the defendant. It is claimed that it is very hard to get justice, on the ground that the sympathy of the court (consulate) is usually with the defendant, and under these conditions the costs of court are very high. Foreign merchants who find it necessary to bring suit against insolvent Turkish firms will always do better to compromise rather than bring the matter to court.

NORWAY AND SWEDEN.

In these countries the only thing for a creditor to do is to send in his claims and make sure that the same are recognized. After this has been done he has the right to refuse to accept the propositions offered by the bankrupt, and can insist upon court proceedings.

Card Systems and Diagrams—Keeping Track of Stock—Factory Management.

BY J. S. V. BICKFORD.

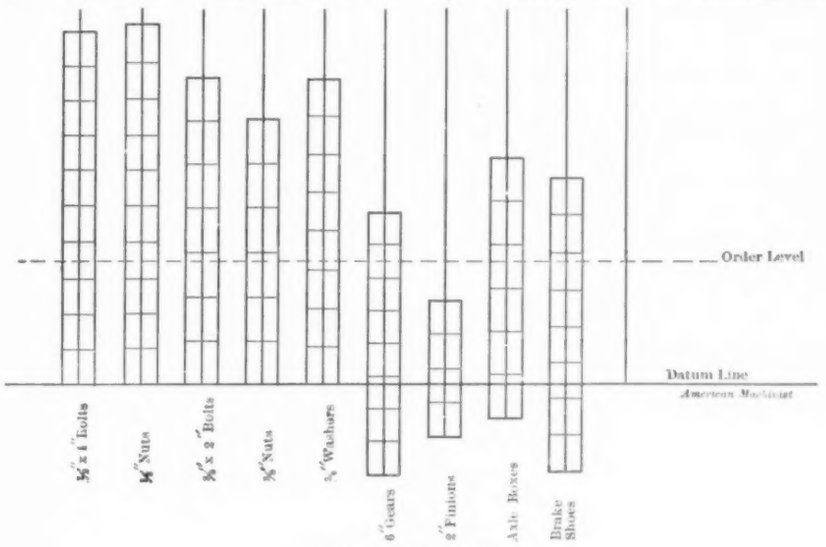
In considering the methods of factory management which have resulted in success, it has struck me that they fall naturally into two main classes. On the one hand is that class of factory which depends on the individual capacity of its employees and on the other the one depending on the perfection of its system for its results.

I think it must be conceded that in the hands of the man who is an expert in choosing men the former system gives, during the time in which the particular factory is under the direct supervision of its organizer, the better results. It may be taken as an axiom that any man who is really good at selecting men need do nothing else in this life and need have no other qualifications in order to make a large fortune. In most cases I believe that this faculty is combined with organizing ability, but it need not necessarily be so, for it is obvious that if a man is an absolute master of selection he can select a manager and this manager can be entrusted with the organization, but, as I have said, it usually happens that the peculiarly gifted individual who can judge a man at sight and what he is fit for in five minutes' conversation is also gifted with a considerable ability in organization.

I have also been struck on many occasions by the absence of the ability in successful men to ascribe to its proper cause their own success. I read some time since interviews with half a dozen first-class self-made men who were asked to what they attributed their own success. Without exception they all talked about business rectitude, sobriety, industry and such like platitudes. Of course everyone knows that without these qualities no considerable success is possible, but most people know that it by no means follows that success will attend the practice of any or all of these virtues. Ability, brain power, accurate and clear thinking, well-balanced judgment are as, if not more, necessary than any of the copybook maxims and without some of these attributes no man can make a success, however industrious he may be.

If a man has not the ability to select subordinates with certainty—and it is an ability which I believe is born, not created by education—his only chance is to so arrange matters that practically anyone can carry on the business by the routine he originates. This is the secret of success of many of the most elaborate card systems in use and some of them are nearly perfect. It is a matter of great difficulty to judge these systems and by no means easy to follow an explanation of them. I have read Mr. Arnold's work on Factory Management which is practically devoted to a few card systems in use in the United States. The impression left on my mind is that they are, in most cases, carried to excess. There are a few main points which a card system must take care of, and I think that great caution should be exercised that a card system is not carried too far.

It is above all things necessary to ascertain the cost of the factory product, and that the head of the factory should be able to see, almost without trying to do so, if any product is rising in cost, if there is a large increase in wasters in a department, and so on. If this information is recorded on the ordinary card it requires a somewhat careful examination to detect a serious rise, and I would suggest that all such information be recorded in the form of curves. Take the case of the cost of the product or any minor component of it. I propose that a single sheet of squared paper, properly printed, be set aside for each component. This would be ruled at the bottom in lines for such information as the piece-work price, workman's number, date, etc., and at the top for the name and number of the piece with the operation. The whole of the middle of the sheet, which should be of considerable size, would then be given up to cost curves. Each horizontal line would represent so many cents or dollars, as the case might be, and the vertical lines would represent periods between the turning out of each subsequent set of like components. Your readers will easily follow the result. Each batch of components would be averaged and a dot be placed on the paper to represent cost. By joining up these points a curve would be formed and a glance would show if the labor or material cost of the product (both could be kept on the same card) was rising by the curve rising to a peak. Of course such a peak should be inquired into at once. My own impression is that nothing but good would follow the publication of these curves in the factory, by causing interest and emulation among the men. It would not be necessary that the actual value of the squares should be published—*i. e.*, the curve would not give the workmen the actual cost of the part, but only its relative cost from day to day. Of course difficulties crop up. For instance, a price may be fixed for the part from year to year, and in that case, so long as the workman earns the price, the cost to the firm will be the piece-work price, and the curve a straight horizontal line which would be of no use to anyone, unless the interest and depreciation on the machine used, reduced to cents per hour, were added to the piece-work price and shown on the same sheet either as a separate curve or compounded with the wages cost. In this case the saving to the firm due to more rapid output would be accurately shown. In any case the actual time in hours should also be shown by a separate curve, and, on the whole, I believe the best results would follow the use of these separate curves: (1) Time (the workman's wage rate being shown in figures at base of card); (2) depreciation and interest cost; (3) material cost. All could easily appear on one card, especially if kept in colored inks. A horizontal line would serve to indicate the time allowed on piece work for the job.



A STOCKROOM SYSTEM.

Another most important thing to know is the state of the stock in advance. At page 1326, Vol. 26, I recommended the use of wire rods with rings on them to indicate the state of the stock, the idea being to divide the stock into sets, each set representing the number of pieces in the product (the product being supposed to be one article only) and to use one ring to represent a set. One vertical metal rod would then be set up for each sort of stock, and a ring put on the corresponding rod for each set of stock in hand. Obviously, if there were enough pieces of stock in hand for the production of five complete machines there would be five rings on each rod, and a single glance along the rods would show the condition of the stock. Difficulties crop up in practice. For instance, what is to be done when several different products draw such stock as bolts and nuts from one store? We can-

not follow the plan in that particular case in its simple form, and my own impression is that in that case the best results would follow the simplest possible form—*i. e.*, use one ring for each piece and have a pointer or colored ring to indicate the ordering and danger level. Another difficulty has occurred to me: Suppose we are making such a thing as a motor car, and stock not only simple things like bolts and nuts, but finished components such as back axles. Some of the bolts in the ordinary stock are used in the finished article, and suppose we have in store two dozen ½x4-inch bolts, while six are used on one back axle and we also have two back axles in stock. We obviously have three dozen bolts in all, and the obvious thing is to put six rings (supposing six bolts to constitute a set) on the corresponding rod. But suppose it is desired to know if there are enough components in hand for six back axles. Our stock rings tell us there are, but that is not true; two sets are made up. There are bolts enough for making six finished cars, but not enough for six new axles. This is rather a difficult problem, and I may say at once that I hardly recommend an attempt at its solution. Were I introducing it I should leave this to the intelligence of the storekeeper to point out, and should fire him if he had not enough common sense to point out the facts. It may, however, be of interest to point out possible solutions. One is to use different colored rings to represent stock used in components in store. Another is to have the rods themselves movable, so that they can be lowered when some of that particular stock is in hand already made up. The effect would be, so to speak, to add rings below the datum line when stock was in hand already made up. I give a rough sketch of the idea in the illustration.

It will be noted that the underlying idea of both this rod stock index and the above mentioned cost-keeping system is a curve. I am a great believer in curves, so long as they are not abused; but they are very often made out in such a way as to be anything but guides. For instance, a curve, to be of any actual use, should be so made that the curve rises when the value it represents rises. Often you will see a curve arranged so that its distance from the left- or right-hand edge of the paper depends on the value to be represented, and I have often turned my newspaper upside down to really get at what the author means to convey by his curve, and sometimes I have turned it around several times without getting the ghost of a notion of what he meant. Anyone can understand a plain, common or garden curve which goes up when cost goes up and *vice versa*, and he does not want to spend ten seconds in examining the cost sheet of a whole year either, in order to see if the cost of a component has gone up or down or fluctuated wildly.

I wonder how many men running small businesses know how wildly the cost of a component may vary. I recently started careful cost keeping in a new works and, naturally, with the hundreds of cards the men could not keep the whole in mind. The result was that I found one job done on one occasion in three hours reported three months later as requiring twenty-four. These little things open one's eyes, and I know for a fact there had not been much deliberate "slacking."

The next thing to know is how each factory department is off for work and who is in want of the next job. In this particular I was much struck with the Cottrell plan as given in Mr. Arnold's book. It consists in leaving the directing of stock, etc., into and out of departments to one central clerk who has on his desk racks of cards, one card going with each component passing through the factory and one rack assigned to each department. It will be seen that this is the curve idea again. It is not difficult to make the racks approximately correspond to the size of the department so that when the rack is nearly full the department will have its fill of work on hand, and in this way the merest glance will show where work is wanted.

There is yet another point I should like to touch upon. It is not at all difficult, where men are on piece work, to have a lot of time wasted (at least nominally) between jobs by a job being supposed to be finished, say, a couple of minutes before it is. I recently had a first-class plan of meeting this difficulty laid before me by the Rochester people. It consisted in making the man take his piece card to the time recorder and print his time at starting and finishing. Of course there is nothing to prevent his going after he has started the job, but he runs across a difficulty if he does that. Suppose he sees he will finish in about five minutes and goes and punches his card as finished. In the first place there is the risk of the foreman coming around and seeing the card (which is in a rack in full view) during that five minutes. But that is not all. At the end of the week the totals of the times recorded in the above manner are added p and balanced with the man's time in the factory and the difference (there is bound to be some) is the foreman's debit. This time lost debit placed on a chart for the foremen themselves and the factory head to see is a most salutary check. A good foreman will have very little wasted time; a bad one, much. The man on piece work will take good care he does not fudge the times the wrong way and he will take care they do not understate.

It may be noted that the Cottrell Company use a system of piece work which has been in use in this out of the way and in some respects Old World county for many years. In no case, during his employment, is a man's wages for the week permitted to fall below his nominal weekly rate even if he does not make his wages on piece work. That is to say, suppose a man makes 20 pieces at piece work at $1.00 each and his nominal pay for the week if working day work is $25.00, he gets his $25.00 and not the lower rate earned at piece work. On the other hand, he of course gets all he can make above his wages. The effect is of course a sort of "heads I win tails you lose" arrangement which at first sight seems all in favor of the men, but is not really so. Speculation is the privilege of capital, but a man with a wife and family has no right to speculate with his income. Further than that it gives much greater freedom to the employer in fixing rates, for the man cannot lose over the matter.

Colonial Preference to British Goods.

British manufacturers—and especially those engaged in the engineering and machinery industries—are becoming more and more discontented with and suspicious of the so-called colonial preferential tariffs now in force. The latest additions to the list are South Africa and New Zealand, and they are both more niggardly in their treatment of British goods than the tariff of the Dominion. As regards the latter, an examination of the tariff discloses the main reason for this comparative failure of the much-lauded preferential system of Canada. The grievance is in the list of free imports, which contains scores of items which British manufacturers would like to see on the preferential schedules—for instance, machinery for sugar factories, of which the Dominion last year bought $80 worth from Great Britain and $603,142 from the United States. It is claimed by British makers that they have fitted up many of the largest sugar factories in the world, and are quite equal to supplying the same to Canada. It is the same, too, with cream separators, surgical instruments, steel and wire goods, mining and smelting machinery, sewing machines, wire fencing, etc. Our exporters say bitterly that if the preferential system is to be applied at all, it should be applied where it would benefit us most. It is the same with the South African tariff. It provides for a 2½-per-cent. schedule of duties, which are removed when the goods are of British origin; it also provides for a schedule of *ad valorem* duties from which we may deduct 25 per cent. as against foreign competitors; and then comes a free list, open to all the world. Manufacturers complain that contracts show that under either this free list or under the 2½-per cent. schedule foreign competitors are able to secure orders just the same as before. New Zealand is a trifle better, but there they have given preference in goods we either cannot or do not supply and have withheld it in cases where the competition is very keen. The New Zealand preference duties apply only to about £2,000,000 worth of the imports, which total £12,000,000. They leave out agricultural implements and machinery,

fencing wire and such like lines which British dealers could supply with a preference duty, and in fact do already supply, altho the competition from the United States and Canada is especially severe.

American exporters have an enormous advantage over their British competitors in the preferential freight charges accorded them by British shipowners. For instance, a case is quoted by a New Zealand correspondent. The writer states that goods, the f. o. b. prices of which are practically the same, can be imported into the colony from the continent *via* London at a much cheaper rate than if imported direct from England. This is due to the action of British shipowners, their rates from the continent being 22s. 6d. per ton, and from Great Britain 42s. per ton. The goods referred to are landed in the colony, costing 15s. for the foreign and 18s. for the English article. Practically a 25-per-cent. preferential duty is needed to put the British manufacturer on the same footing as the foreign maker. These same favorable terms are accorded American exporters by British shipowners.

The Australians want to make their own locomotives, but it is very doubtful if they will be able to do more than import all the parts and put them together. Most of the sewing machines "made" in Australia are all imported in parts, and this applies to scores of machines, etc. It is doubted by experts whether a first-class locomotive could be constructed in Australia, even with the aid of imported parts, at a cost of less than 10 to 15 per cent. of the imported article, even with duties and freight added. Also the demand for locomotives in the Commonwealth will not for years to come justify the establishment of large factories like you have in the States and we possess in England. It is stated here that one large American house is considering the feasibility of establishing branch works near Sydney. By the way, I may add that most of the railroad companies in Spain are seeing to the renewing of a good portion of their rolling stock, such as locomotives, passenger cars, goods trucks, etc. It would be worth the while of some United States firms to look after the business.

A correspondent writes from Tientsin (China) on the subject of British and American and German machine tools, oil engines and similar goods. He says that American machine tools work out higher than British, but yet very many are imported. If a dealer asks a British maker to consign a sample he invariably either wants full payment or a heavy percentage. The average importers don't feel disposed to lay out their capital on costly samples.

London, England. F. C. C.

On May 1 stamps commemorative of the Louisiana Purchase Exposition will be placed on sale at the postoffices throughout the country. There are to be 90,000,000 one-cent and 225,000,000 two-cent stamps.

A Special Bath—Annealing for Toughness.

BY E. R. MARKHAM.

It is sometimes desirable to quench articles of steel in a bath of water and before they are cold and cease contracting to remove them from the water and place them in oil. This is especially true of such articles as milling cutters, some forms of punch press dies, etc.

Now, it is possible to do this by having two baths located near each other, and when the article has cooled sufficiently to remove the piece from the water and plunge it into the oil, allowing it to remain there until cold. For certain small articles, however, or for pieces of peculiar construction, this might not prove satisfactory—that is, it might not be desirable to allow the article to come in contact with the air when moving from one bath to the other.

When such is the case a form of bath is

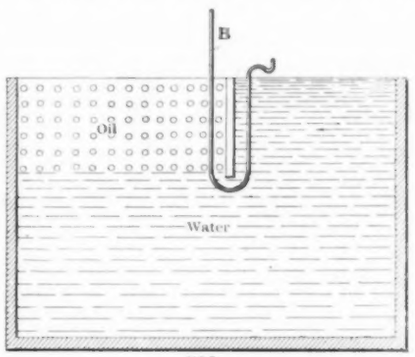


FIG. 1

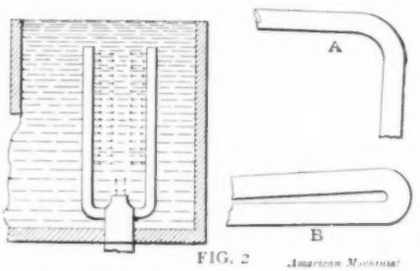


FIG. 2 *American Machinist*

OIL AND WATER TANK.

used which eliminates this objection. This bath is shown in Fig. 1 and is easily made. An ordinary rectangular tank has a partition *A* which extends down for a distance corresponding to the depth of oil necessary to accommodate the pieces to be hardened. The tank is first filled with water to a hight that allows for the oil needed, and the oil is then turned in on top of the water on one side of the partition, as shown. Being lighter than the water, it will of course stay on top and on its own side of the partition; care must be exercised as to the amount of water we have in the tank; if we do not have enough, the oil will of course get under the partition and appear on the surface on the water side of the bath. Should this occur, we can by adding sufficient water raise the bottom level of the oil above the lower edge of the partition. It will be necessary to skim off any oil that may have got over on the water side.

I have seen tanks made with a piece of glass in one end, this glass having a mark corresponding to the lower edge of the partition so that the hight of the water could be readily seen.

A wire hook made as shown at *B* is provided, this hook reaching down by the lower edge of the partition and up above the surface on the water side. The work to be hardened is placed on this hook and lowered into the water. When it has been in the water long enough it may be drawn under the partition and up into the oil, where it may remain until it has cooled to the temperature of the oil. To save time the hook may be hung up or fastened in some manner so that the work will be suspended at the proper hight in the oil and the operator may continue with the hardening of other pieces while this is cooling.

This bath may be elaborated as much as may be considered desirable. A supply pipe and overflow may be provided for the water side, or pipes having perforations to project water toward a center, as shown in Fig. 2, the work being passed down between the pipes, as illustrated in a previous article of mine.

ANNEALING FOR TOUGHNESS.

It is sometimes desirable to make steel very tough. While the regular methods of annealing cause steel to be much tougher than it would be if left unannealed, yet it does not reduce brittleness to a degree that makes it safe for certain purposes. I have experimented with pieces which when packed with granulated charcoal and annealed in the most careful manner would break when bent at an angle of 90 degrees, as at *A*. The steel used was 70-point carbon open hearth. This same steel when placed in a furnace heated red hot and allowed to cool off with the furnace would bend to about 100 degrees; but even this when tested as it was to be used in a machine would break.

It was decided to test a method we had used with success on another class of work. The pieces were heated to a low red, plunged in oil and allowed to remain there until cold. They were then placed in an oven and again heated red hot uniformly throughout, removed and placed where no current of air could strike them, where they would not come in contact with dampness, and allowed to cool. When tested it was found that they could be bent around as shown at *B*, and showed no tendency to break; they seemed to bend as tho very stiff. When machined they were very free from hard spots, so common in high-carbon, low-grade steels; in fact, it was claimed that the pieces treated in this manner worked very nicely in all the operations of machining and in the tests to which they were subjected.

For many purposes the high cost of the operation would make it prohibitive, but where it is necessary to produce a very tough effect without sacrificing durability and the quality of being readily worked, I think it is especially valuable.

Gas Engine Design Constants and Formulas.

BY SANFORD A. MOSS, PH.D.

The following table is the result of an investigation of gas-engine properties begun by the Department of Machine Design, Cornell University, about a year ago. Data as to engine proportions were received from twenty builders for seventy-six different sizes, more or less completely.

It is a matter for congratulation that so many builders were sufficiently broad-minded to furnish the proportions of their engines. Of course a number of other builders refused to furnish data because they did not want to give away their trade secrets. Such a spirit is certainly blameworthy, since an investigation such as the present one alike benefits the builders who assist it, the university which makes it, and the engineering fraternity in general.

These data were worked up by the methods explained in an article at page 1345, Vol. 26, of the AMERICAN MACHINIST, on "Determining Design Constants from Practice."* Rational formulas were first deduced by the methods given very briefly in the table. The numbers in the column "Corresponding Numerical Values of Coefficient of Formula" were then obtained directly from the engine data. These coefficients therefore give the practise of the twenty builders, and fairly represent American practise. The values of the rational "Design Constant" given in the table were then computed from the numerical coefficients.

To illustrate the use of the formulas, take the first one given, for thickness of cylinder wall, $t = \frac{1}{2S} pD + \frac{1}{4}$. The values of $\frac{1}{2S}$ found from the data varied from .000308 to .000133, the average value being .000204. Hence the thickness of the cylinder wall of an engine being designed may be from .000308 $pD + \frac{1}{4}$ to .000133 $pD + \frac{1}{4}$, the best value being .000204 $pD + \frac{1}{4}$. The stresses in the cylinder wall to which these coefficients correspond are 1625, 2450 and 3750. It is to be remarked that the stresses computed are perhaps open to criticism, since the formulas may not take everything exactly into account. The numerical coefficients given are absolute, however, being taken from the actual data, and may safely be used, even tho the exact stresses, bearing pressures, etc., to which they correspond may not be known.

There are also given in the last column rough formulas for average cases. For instance, in the case of the cylinder wall, the rational average formula is $t = .000204\ pD + \frac{1}{4}$. This gives a thickness varying with the maximum pressure p. In an average case p is 300, and if this value is substituted for p we have $t = (.000204 \times 300)\ pD + \frac{1}{4}$, or very nearly $t = \frac{D}{16} + \frac{1}{4}$. This formula of course should not be used where the pressure is much different from 300. Formulas like those in the last column are given in the few works on gas-engine design, without qualification, which is not correct, as these formulas have a very limited range. The "Rational Formulas" given, with the mean values of the numerical coefficients substituted, are the proper formulas for general use.

The maximum explosion pressure in the engines examined varied from about 250 pounds per square inch to 350, the average being 300 pounds per square inch. The compression pressure varied from about 50 to 100, the average being 70 pounds per square inch. The lower values of compression pressure and maximum pressure are for engines using gasoline, and the higher values for natural gas. This is of course due to the fact that pre-ignition must be avoided.

The maximum horse-power which an engine can develop is found to average very closely 1⅛ times the rated horse-power for which the engine is sold.

The mechanical efficiency averages about 80 per cent. The engines examined were single-cylinder horizontal or single or multicylinder vertical engines, all single acting, varying from 5 to 100 horse-power, and the formulas given apply only to such engines.

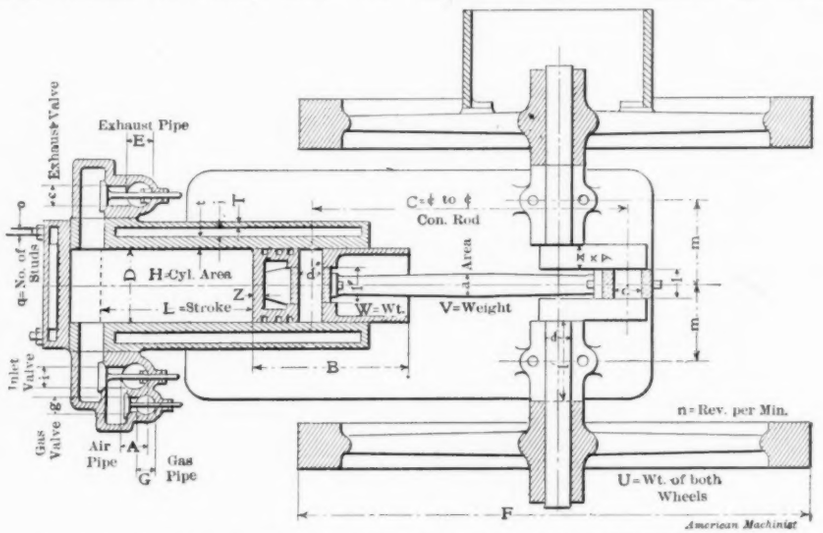


FIG. 1. GAS ENGINE DIAGRAM SHOWING NOTATION. ALL DIMENSIONS IN INCHES.

*The data were originally worked up by Messrs. H. L. Koenig and G. W. Rice, students of the class of 1903, as their graduating thesis. An abstract of this was published in *Sibley Journal*, June, 1903. Since this, the entire data have been worked up again, the methods and results corrected, and the whole matter recast by the writer.

Engine Dimension and Name of Design Constant upon which it Depends.	*Notation. All Dimensions in Inches, All Pressures and Stresses in Pounds per Square Inch.*	*Methods Used and Assumptions Made in Deriving Rational Formula. Single Acting Trunk Piston Always Assumed.*	*Rational Formula for Engine Dimension in terms of the Design Constant.*	*Maximum, Mean, and Minimum Values of Design Constant.*	*Corresponding Numerical Values of Coefficient of Formula.*	*Assumptions made in Deducing Formula for Average Cases from Rational Formula Mean Value of Design Constant always used.*	*Reduced Formula for Average Cases.*
Thickness of cyl. wall. Stress in cyl. wall.	t=thickness of cyl. walls. S=stress in cyl. walls. p=max. pressure. D=dia. of cylinder.	Cylinder considered as a pipe with uniform fluid pressure. Constant added to thickness to allow for crooked cores, reboring, etc.	$t=\left(\frac{1}{2S}\right)pD+\frac{1}{4}$	S= 1,625 2,450 3,750	$\frac{1}{2S}$ = .000308 .000204 .000133	p=300	$t=\frac{D}{16}+\frac{1}{4}$
Thickness of jacket walls.	T=thickness of jacket wall. t=thickness of cyl. wall.	Jacket wall reasonably assumed as proportional to cylinder wall.	T=ct	c= .86 .60 .43			T=.6t
Thickness of water jacket space.	j=thickness of jacket space. t=thickness of cyl. wall.	Jacket space reasonably assumed as proportional to cylinder wall.	j=ct	c= 1.85 1.25 1.00			$j=1\frac{1}{4}t$

Engine Dimension and Name of Design Constant upon which it Depends.	Notation. All Dimensions in Inches, All Pressures and Stresses in Pounds per Square Inch.	Methods Used and Assumptions Made in Deriving Rational Formula. Single Acting Trunk Piston Always Assumed.	Rational Formula for Engine Dimension in terms of the Design Constant.	Maximum, Mean and Minimum Values of Design Constant.	Corresponding Numerical Values of Coefficient of Formula	Assumptions made in Deducing Formula for Average Cases from Rational Formula. Mean Value of Design Constant always used.	Reduced Formula for Average Cases.
Number of cyl. head studs.	q=number of cyl. head studs. D=diameter of cyl.	Number of studs reasonably assumed to increase with cylinder diameter, but not quite in proportion to it.	$q=cD+2$	c= 1.14 .67 .40			$q=\frac{2}{3}D+2$
Outside dia. of cyl. head studs. Stress in cyl. head studs.	o=outside diameter of cyl. head studs. q=number of cyl head studs. p=maximum pressure. D=diameter of cyl. s=stress at root of thread.	Initial load due to screwing up nuts assumed to be just equal to load due to explosion. (The explosion does not cause any appreciable addition to the stress caused by screwing up.) The nuts may, of course, be unnecessarily screwed up tighter, causing unknown additions to the stresses given. Area at root of thread is 0.7 body area in average studs.	$o=\frac{1}{\sqrt{.7s}}\sqrt{\frac{p}{q}}D$	s= 10,900 7,800 4,500	$\frac{1}{\sqrt{.7s}}=$ .0115 .0135 .0179	p=300 q=8. This is correct for 9" cylinders and nearly correct for quite a range on either side	$o=\frac{D}{12}$
Length of stroke in terms of cyl. diam.	L=length of stroke. D=cyl. diameter.	Length of stroke reasonably assumed as proportional to cylinder.	$L=cD$	c= 1.8 1.5 1.0			$L=1\frac{1}{2}D$
Length of con. rod. Ratio of con. rod to crank.	C=distance from center to center of connecting rod. u=ratio of con. rod to crank. L=length of stroke.	Connecting rod reasonably assumed as proportional to crank length.	$C=u\frac{L}{2}$	u= 4.10 5.15 6.00			$C=5\frac{L}{2}$
Weight of piston.	W=weight of piston. H=area of cyl.$=\frac{\pi}{4}D^2$	Piston weight reasonably assumed proportional to cylinder area.					$W=1.3H$
Weight of con. rod.	V=weight of con. rod. H=area of cyl.$=\frac{\pi}{4}D^2$	Rod weight reasonably assumed proportional to cylinder area.					$V=.8H$
Total weight of reciprocat'g parts. Wt. of recip. parts per sq in. of cyl.	W=total wt. of piston. V=" " con. rod. H=area of cylinder. w=weight of truly reciprocating parts per sq. in of cyl.	It can be shown mathematically that the centrifugal force and inertia of the connecting rod, etc., are exactly taken account of, if ½ of its weight is counted as reciprocating with the piston.	$W+\frac{1}{2}V=wH$	w= 1.02 1.70 2.42			$W+\frac{1}{2}V=1.7H$
Length of piston. Bear'g pressure on piston due to con. rod thrust.	B=length trunk piston. b=bearing pressure on projected area of piston (mean value during work'g strk. u=ratio of con. rod to crank. p=maximum pressure D=cyl. diameter.	As is well known, the thrust on the piston due to the connecting rod is inversely proportional to u. An indicator diagram for an average case was constructed and the rod-thrust during the working stroke found by well-known means. The mean value came out: $\frac{.22}{u}\,p\,\frac{\pi}{4}\,D^2$	$B=\left(\frac{\pi}{4}\frac{.22}{b}\right)\frac{pD}{u}$	b= 9.6 6.9 4.8	$\left(\frac{\pi}{4}\frac{.22}{b}\right)=$ .018 .025 .036	p=300 u=5	$B=1\frac{1}{2}D$
Bear'g pressure on piston due to weight.	b′=bearing press. on proj. area of piston due to wt. of itself and portion of con. rod supported by it w=wt. of recip. parts per sq. in. of cyl. D=diameter of cyl. B=length of piston.	In an average case, ½ of the weight of the rod is taken by the piston, for both horizontal and vertical engines. Hence the total load due to weight is equal to the weight of the truly reciprocating parts.	$b'=\frac{\frac{\pi}{4}wD}{B}$			w=1.7 B=$1\frac{1}{2}D$	$b'=.89$
Thickness of rear wall of piston. Stress in rear wall of piston.	z=thickness of rear wall of piston. s=stress in rear wall of piston. p=max. pressure. D=cyl. diameter.	Rear wall of piston considered as a flat plate fixed at the circumference and without ribs. Actually the plate is not quite as rigid as if fixed at the circumference, but there are ribs which make up. Actually the stresses are not as high as given, on account of the ribs.	$z=\left(\frac{.41}{\sqrt{s}}\right)\sqrt{pD}$	s= 2,860 5,320 10,200	$\left(\frac{.41}{\sqrt{s}}\right)=$ .00766 .00562 .00405	p=300	$z=\frac{D}{10}$

Engine Dimension and Name of Design Constant upon which it Depends.	Notation. All Dimensions in Inches, All Pressures and Stresses in Pounds per Square Inch.	Methods Used and Assumptions Made in Deriving Rational Formula. Single Acting Trunk Piston Always Assumed.	Rational Formula for Engine Dimension in terms of the Design Constant.	Maximum, Mean, and Minimum Values of Design Constant.	Corresponding Numerical Values of Coefficient of Formula.	Assumptions made in Deducing Formula for Average Cases from Rational Formula. Mean Value of Design Constant always used.	Reduced Formula for Average Cases.
Length and diam. of wrist pin or piston pin. Stress and bearing pressure on wrist pin.	d″=diam. of wrist pin. l″=length of wrist pin. p=max. pressure. D=diameter of cyl. s=stress in wrist pin. b=bearing pressure on projected area of wrist pin due to maximum load.	The wrist pin is considered as a beam, uniformly loaded and supported at the ends of the connecting rod journal. Actually the center of support is somewhat beyond, but the load due to the explosion pressure is not uniformly distributed, being more intense near the supports owing to slight deflection of the pin; these compensate each other. The bearing pressure is found for the maximum load, as is usual for steam engines, the important matter being that the oil must not be squeezed out.	$d''=\sqrt[4]{\frac{\pi}{4sb}}\sqrt{p}\,D$ $l''=\sqrt{\frac{\pi s}{4b}}\,d''$	s= 13,300 10,500 10,000 b= 3,900 2,800 2,260		p=300	d″=.22D l″=1 ¾d″
Area of mid-section of con. rod. Factor of safety in con. rod, considered as a long column.	a=area of mid-section of con. rod. k=factor of safety of rod or ratio of breaking load by Ritter's formula to actual l'd. C=distance, center to center of rod. R=diam. of mid-sect'n if round. Q=hight of mid-sect'n if rectangular. r=radius of gyration of mid-section. $r^2=R^2/16$ or $Q^2/12$ p=max. pressure. D=diameter of cyl.	The maximum load on the rod, taking account of inertia and obliquity, is the same as if these refinements are neglected. Ritter's formula for columns is used. End coefficient = 1, for ends free but guided. For mild steel, the usual material, elastic limit = 35,000, mod. of elasticity = 29,000,000.	$a=\frac{k}{44{,}560}\,pD^2\times\left(1+\frac{.00012C^2}{r^2}\right)$	k= 5.44 3.90 2.23	$\frac{k}{44{,}560}=$ .0001220 .0000875 .0000500	p=300 Round rod assumed. $1+.00012\times\frac{C^2}{r^2}$ is given theaver'ge value 1.6	R= 23D
Length of arm of bending moment on crank pin in terms of cyl. diam.	l=length of crank pin journal. l′=length of main bearing journal. 2m=distance from center to center of main bearings. M=m−(⅝l+¼l′)=arm of effective bending moment on crank pin, for reaction on main bearing due to explosion.	Treatment is rigid for a single cylinder center crank engine with two overhanging flywheels. Formulas apply approximately for multicylinder engines with a main bearing between each crank pin. If the crank shaft is absolutely rigid under the explosion, the bearing pressures are uniformly distributed over crank pin and main bearing. If the crank shaft is very flexible, the pressures due to the explosion act only at the edges of the bearing. The actual case is taken to be a mean between these two, giving as the effective arm of the bending moment $m-(\frac{5}{8}l+\frac{1}{4}l')$. This distance is reasonably assumed as proportional to the cylinder diameter.	M=cD	c= .450 .609 .850			M=.6D
Diameter of crank pin. Stress in crank pin.	l=length of crank pin journal. l′=length of main bearing journal. 2m=distance from center to center of main bearings. M=m−(⅝l+¼l′). d=diam. of crank pin. s=stress in crank pin. D=diameter of cyl. p=max. pressure.	Treatment is rigid for a single cylinder center crank engine with two overhanging flywheels and outside belt pulley. Formulas apply approximately for multicylinder engines with main bearings between each crank pin and for direct-connected or geared engines. Bending moment due to explosion pressure found as stated above. The inertia of the reciprocating parts decreases the bending moment and the fact that the explosion occurs slightly after the dead center when the con. rod is oblique, increases it. The centrifugal force of the con. rod and counterbalances, the weight of the flywheels, and the belt pull, all cause additional bending moments. Diagrams were made taking all these effects into account, showing that the resultant bending moment is practically the same as found by neglecting inertia and other refinements. That is, the total explosion pressure, acting at the dead center, is to be taken to find the bending moment.	$d=\sqrt[3]{\left(\frac{4}{s}\right)MpD^2}$	s= 18,800 10,600 7,500	$\left(\frac{4}{s}\right)=$ .000213 .000379 .000533	M=.6D as found above p=300	d=.41D

Engine Dimension and Name of Design Constant upon which it Depends.	Notation. All Dimensions in Inches, All Pressures and Stresses in Pounds per Square Inch.	Methods Used and Assumptions Made in Deriving Rational Formula. Single Acting Trunk Piston Always Assumed.	Rational Formula for Engine Dimension in terms of the Design Constant.	Maximum, Mean, and Minimum Values of Design Constant.	Corresponding Numerical Values of Coefficient of Formula.	Assumptions made in Deducing Formula for Average Cases from Rational Formula. Mean Value of Design Constant always used.	Reduced Formula for Average Cases.
Length of crank pin. Bear'g pressure on crank pin.	l=length of crank pin journal. d=diam. of crank pin. b=bearing pressure on projected area of crank, due to the average value of load for a complete cycle.	A typical indicator diagram was constructed, and from it the pressure on the crank pin at each crank pin position found, taking account of obliquity of rod, inertia of reciprocating parts, and centrifugal force of rod. The average value of this total pressure (taken regardless of direction) throughout a complete cycle was 14½ per cent. of the maximum load on the piston due to the explosion. This ratio is assumed as the same for all cases. The safe crank pin bearing pressure is found to be independent of the velocity.	$l=\left(\frac{.145\pi}{4b}\right)\frac{pD^2}{d}$	b= 158 213 348	$\frac{.145\pi}{4b}=$ .000720 .000535 .000327	d=.41D from above. p=300	l=.95d
Thickness of crank throws.	x=thickness of crank throws (in direction of shaft axis). d=diam. of crank pin.	Thickness of crank throws reasonably assumed as proportional to diameter of crank pin. Center crank assumed.	x=cd	c= .46 .63 .80			$x=\frac{5}{8}d$
Breadth of crank throws.	y=breadth of crank throws (perpendicular to shaft axis). x=thickness of crank throws (in direction of shaft axis).	Breadth of crank throws reasonably assumed as proportional to thickness. Center crank assumed.	y=cx	c= 1.50 2.12 3.00			$y=2\frac{1}{5}x$
Length of arm of equivalent bending moment on crank shaft, in terms of cyl. diam.	l′=length of main bearing journal. L=length of stroke. D=diameter of cyl. M′=(.325 l′+.090 L)=arm of equivalent bending moment on crank shaft (at inner edge of main bearing) for reaction on main bearing due to explosion.	Treatment is rigid for a single cylinder center crank engine with two overhanging flywheels and outside belt pulley. Belt pull assumed towards engine cylinder, as this is the worst case. Formulas apply approximately for multicylinder engines with main bearings between each crank pin, and for cases where belt pull is in a different direction, or for direct-connected or geared engines. From the diagrams already alluded to it was found that the bending moment equivalent to the maximum combined bending and twisting moments on the crank shaft (taking everything into account) is the same as if the main bearing reaction due to the explosion had the arm .325 l′+.090 L. This distance is reasonably assumed as proportional to cylinder diameter.	M′=cD	c= .324 .400 .468			M′= .4D
Diameter of crank shaft. Stress in crank shaft.	s=stress in crank shaft at inner edge of main bearing journal. d′=diam. of crank shaft at main bearing. l′=length of main bearing journal M′=(.325 l′+.090 L). D=diameter of cyl. p=max. pressure.	Treatment applies to cases specified immediately above. Equivalent bending moment on crank shaft found as stated above.	$d'=\sqrt[3]{\left(\frac{4}{s}\right)pD^2M'}$	s= 14,400 9,500 6,200	$\left(\frac{4}{s}\right)=$ .000278 .000422 .000644	M′=.4D from above. p=300	$d=\frac{3}{8}D$
Length of main bearing journal Bear'g pressure on main bearings.	l′=length of main bearing journal d′=diam. of main bearing journal. b=bearing pressure on projected area of main bearing, due to average value of load for a complete cycle.	Treatment is rigid for a single cylinder center crank engine with two flywheels and outside belt pulley. Belt pull assumed as away from engine cylinder, as this is the worst case. Treatment applies approximately to other cases. Diagrams were constructed and the pressure on the main bearings found for each crank position, taking account of everything. The average value of the total load (taken regardless of direction) throughout a complete cycle was ⅓ of the maximum load on the piston due to the explosion. This ratio is assumed as the same for all cases. The safe bearing pressure is found to be independent of the velocity.	$l'=\left(\frac{\pi}{24b}\right)\frac{pD^2}{d'}$	b= 174 123 98	$\left(\frac{\pi}{24b}\right)=$ .000752 .001068 .001334	d′=⅜D p=300	$l'=2\frac{1}{4}d'$

Engine Dimension and Name of Design Constant upon which it Depends.	Notation. All Dimensions in Inches, All Pressures and Stresses in Pounds per Square Inch.	Methods Used and Assumptions Made in Deriving Rational Formula. Single Acting Trunk Piston Always Assumed.	Rational Formula for Engine Dimension in terms of the Design Constant.	Maximum, Mean, and Minimum Values of Design Constant.	Corresponding Numerical Values of Coefficient of Formula.	Assumptions made in Deducing Formula for Average Cases from Rational Formula. Mean Value of Design Constant always used.	Reduced Formula for Average Cases.
Outside diameter of flywheel. Velocity of flywheel rim.	F=outside diam. of flywheel in inches. K=velocity of flywheel rim in feet per min. n=revolutions per min.	The rim velocity of the flywheel is proportional to the stress. The greater this velocity is taken, the less the weight for a given flywheel effect. Hence the rim velocity should have a constant value, regardless of the revolutions per minute	$F=\left(\frac{12K}{\pi}\right)\frac{1}{n}$	K= 4,490 3,220 2,290	$\left(\frac{12K}{\pi}\right)=$ 17,140 12,300 8,750		$F=\frac{12,300}{n}$
Weight of flywheel. Speed fluctuation coefficient.	U=total weight of all flywheels in pounds H. P.=rated horse-power. F=outside diam. of flywheel in inches. n=revolutions per min. f=speed fluctuation coefficient, or ratio of total variation in revolutions per minute to the mean value.	Case taken is single cylinder hit-and-miss engine. Greatest speed fluctuation is at lightest load, which is taken to be when the engine misses three times between each fire. Ratio of energy added to flywheel and causing maximum acceleration; to net indicated energy developed per cycle if exploding every time, is 1.197. Horse-power developed if exploding every time taken as $1\frac{1}{4}$ times rated horse-power, and indicated horse-power taken as $1\frac{1}{4}$ times brake horse-power. Usual crank effort diagram methods used. From a drawing of an average flywheel the radius of gyration is found to be .83 of the outside radius.	$U=\frac{272,300,000,000}{f}\times\frac{H.P.}{F^2n^3}$	f= .034 .054 .091 That is 3.4% 5.4 9.1	$\frac{272,300,000,000}{f}=$ 8,000,000,000,000 5,000,000,000,000 3,000,000,000,000	Above value of rim velocity $F=\frac{12,300}{n}$	$U=\frac{33,000\ H.P.}{n}$
Rotation speed. Inertia force at end of stroke, per sq. in. of piston.	n=rotation speed, revolutions per min. I=inertia force at end of stroke per sq. in. of piston. w=weight of truly recip. parts (piston + $\frac{1}{3}$ con. rod) per sq. in of piston. L=length of stroke, in.	The inertia force at the end of the stroke per square inch of piston is dependent upon the rotation speed, and is a measure of the force tending to shake the engine bed. It should therefore be constant for all engines equally free from vibration. Considerable variation is found, however, compensated for by foundation weight.	$n=\frac{\sqrt{70,382I}}{\sqrt{wL}}$	I= 8.14 15.40 30.80	$\sqrt{70,382I}=$ 757 1,041 1,472	w=1.7 as found above.	$n=\frac{800}{\sqrt{L}}$ This is equivalent to taking the piston speed in feet per min. as $133\sqrt{L}$
Exhaust pipe diameter. Nominal speed of gases thro' exhaust pipe.	E=exhaust pipe diam. v=nominal speed of gases thro' exhaust pipe, ft. per minute. n=revolutions per min. L=length of stroke. D=diameter of cyl.	The nominal speed of gases is found by assuming that the gases passing through the pipe or valve considered occupy the same total volume as they do when in the cylinder.	$E=\left(\frac{1}{\sqrt{6v}}\right)D\sqrt{Ln}$	v= 8,850 5,730 3,120	$\left(\frac{1}{\sqrt{6v}}\right)=$ .00434 .00539 .00732	$n=\frac{800}{\sqrt{L}}$ as found above. Then E depends on $\frac{4}{\sqrt{L}}$ and hence varies little for differ't values of L. L taken as 12.	E=.28D
Exhaust valve dia. Nom'l speed thro' exhaust val.	e=exhaust valve diam. v=nominal speed thro' exhaust valve. n, L and D as above.	Same as above.	$e=\left(\frac{1}{\sqrt{6v}}\right)D\sqrt{Ln}$	v= 6,750 5,200 3,630	$\left(\frac{1}{\sqrt{6v}}\right)=$ .00497 .00566 .00678	Same as above.	e=.3D
Inlet valve diameter. Nom'l speed thro' inlet valve.	i=inlet valve dia. when there is a valve admitt'g whole charge. v=nominal speed thro' inlet valve. n, L and D as above.	Same as above.	$i=\left(\frac{1}{\sqrt{6v}}\right)D\sqrt{Ln}$	v= 8,330 6,400 4,680	$\left(\frac{1}{\sqrt{6v}}\right)=$ .00447 .00510 .00598	Same as above.	i=.27D
Gas pipe diameter. Nom'l speed thro' gas pipe.	G=gas pipe diam., natural gas. v=nominal speed thro' gas pipe. n, L and D as above.	Same as above. Ratio of natural gas to air for perfect mixture, 1:9. Hence gas occupies $\frac{1}{10}$ of cylinder volume.	$G=\left(\frac{1}{\sqrt{60v}}\right)D\sqrt{Ln}$	v= 6,670 3,700 2,380	$\left(\frac{1}{\sqrt{60v}}\right)=$ .00158 .00212 .00264	Same as above.	G=.11D
Gas valve diameter. Nom'l speed thro' gas valve.	g=gas valve diameter, natural gas. v=nominal speed thro' gas valve. n, L and D as above.	Same as above.	$g=\left(\frac{1}{\sqrt{60v}}\right)D\sqrt{Ln}$	v= 3,330 2,080 1,110	$\left(\frac{1}{\sqrt{60v}}\right)=$ .00224 .00283 .00387	Same as above.	g=.15D
Air pipe diameter. Nom'l speed thro' air pipe.	A=air pipe diameter, natural gas. v=nominal speed thro' air pipe. n, L and D as above.	Same as above. Air occupies $\frac{9}{10}$ of cylinder volume.	$A=\left(\frac{1}{\sqrt{6.67v}}\right)D\sqrt{Ln}$	v= 10,700 6,900 4,500	$\left(\frac{1}{\sqrt{6.67v}}\right)=$ .00374 .00466 .00577	Same as above.	A=.25D

Engine Dimension and Name of Design Constant upon which it Depends.	Notation. All Dimensions in Inches, All Pressures and Stresses in Pounds per Square Inch.	Methods Used and Assumptions Made in Deriving Rational Formula. Single Acting Trunk Piston Always Assumed.	Rational Formula for Engine Dimension in terms of the Design Constant	Maximum, Mean, and Minimum Values of Design Constant	Corresponding Numerical Values of Coefficient of Formula.	Assumptions made in Deducing Formula for Average Cases from Rational Formula. Mean Value of Design Constant always used.	Reduced Formula for Average Cases.
Maximum brake horse-power. Nominal mean effective pressure.	M.P.=maximum brake horse-power. p′=mean effect. press. from area of indi.card. h=mechanical effi'ncy, or ratio of brake to indicated power. P=h p′=nom'l M.E.P. D=cylinder diameter. L=length of stroke. n=revs. per minute.	Theoretically, the M. E. P. varies with the compression pressure and fuel. Actually no law can be found, as other unknown variables exercise greater effect. The M. E. P.'s are found to vary very irregularly, regardless of fuel or compression pressure.	$M.P.=\frac{D^2LnP}{1{,}008{,}500}$ (for four stroke cycle engine.)	P= 50 70 85			$M.P.=\frac{D^2Ln}{14{,}400}$

Foundry Costs, Their Analysis and Reduction.*

BY HENRY HESS.

In order to economically manage a foundry it is necessary to know accurately the various elements of expenditure and, having these, to analyze properly their relation to one another and to the product. The manager is then in a position to check at once any rising tendency of the costs or to bring about a reduction, as the analysis points out an opportunity. No doubt all of this can be, has been, and is being done successfully to-day by many a foundryman to the entire welfare of the business without any conscious or formal analysis or detail accounting. There are many managers of the old school who, through personal experience, a high order of native talent and close touch with every detail, get along without other aids. But in these days of large and growing concerns, it is neither advisable nor safe to rely utterly on one man, no matter how capable, nor yet to the best interests of all concerned to burden the higher officials with the infinite detail work needed to get into sufficiently close personal touch with the entire working routine.

It is quite possible so to present the vital elements of cost that the managing head can at once grasp all salient features, see whether cost is stationary or not, and determine where effort must be applied to check a rise or bring about a reduction. The necessary work forming the basis of analysis can be readily performed by a very ordinary grade of shop clerk, once the routine has been fixed.

To start with, all of the elements of cost must be enumerated. It is well also to assign to each element a value, not so much with the idea that this value is absolutely correct, but rather to have some basis of comparison; experience may be relied upon to gradually bring about correct values. The figures given hereafter are to be taken as having merely an illustrative value; no attempt is made to provide a record of actual or proper costs.

In illustration, the elements of cost are divided among a few main heads as follows, it being understood that for actual work a subdivision more in detail must be used; to enumerate them fully is outside the province of this paper, in which it is intended merely to present in general outlines a successfully used plan:

(*a*) General expense.
(*b*) Fixed salaries.
(*d*) Power.
(*e*) Miscellaneous materials.
(*f*) Labor.
(*g*) Pig and other charging metal.
(*h*) Smelting material.
(*j*) Light.
(*k*) Recovered material.

The collating of the actual amounts of the various items as incurred is best done weekly rather than monthly or at other long intervals, as that will permit the recognition of a defect in time to trace it correctly to its cause and to apply a remedy. Should a longer interval be determined on, that should be four-weekly rather than monthly, in order to avoid the disturbing effect of the varying number of working days in different months, and also because it fits in better with the weekly pay accounts. Such charges as are based on a monthly rate can very readily be converted into an annual and from that to a weekly rate.

Apportionment of the various elements of cost to main divisions is made in accordance with readily apparent principles:

(*a*) General expense: Depreciation and interest charges.

(b) Fixed salaries: All salaries to persons having a fairly certain tenure of office; salaries to minor clerks that are likely to vary in amount should be entered under labor.

(*d*) Power: All charges directly connected with the power plant.

(*e*) Miscellaneous materials: Sand, flour, chaplets, wire, molders' implements, etc.; in fact, all materials not accounted for under heads *g* and *h*.

(*f*) Labor: All payments made to workmen and other persons. Includes all pay not taken care of under head *b*.

(*g*) Charging metal: Everything charged into the cupola, except fuel and flux; also all "medicine," whether added in the cupola or ladle.

Note.—For purposes of comparative analysis these materials should be rated at fixed values, altho they will be purchased at more or less fluctuating rates. In order to take care of the difference between the assumed fixed and the actual fluctuating cost, the difference should be determined at suitable periods, and this difference debited or credited, as the case may be, as a "market equalizer" affecting the profit and loss account. Should the fluctuations be large, it will be advisable to make use of a "special charging account" to properly analyze the influence of various brands of iron and scrap on the cost of the charge. Preference is to be given to determinations at short intervals—say, quarterly—rather than longer ones, as changes can then be ordered made in time to effect economies.

(*h*) Smelting materials: All fuel and flux charged into the cupola; fuel recovered from the bed is to be charged again into the cupola. Fuel for other purposes, such as drying ladles, cores and molds, is to be charged under head *e*.

As the market price of these materials also is apt to vary, and as it is desirable in the analysis to make use of a fixed price, the difference is taken care of by a "market equalizer," as previously explained.

(*k*) Recovered material: This account takes care of all difference between molten iron obtained from the cupola and the salable castings. It is made up of:

1. Equipment: Castings for foundry use, such as weights, flasks, chills, etc.

2. Upkeep: Castings made to repair or replace wastage of foundry equipment.

3. Gates: Gates, cast core irons and frames, sinking heads, and sprues.

4. Wasters: All defective castings.

All of this material will either be present in the foundry or will be charged into the cupola as scrap. In the latter case it is certainly to be rated only at the same value as purchased scrap. In the first case it is conservative policy to

* From the Proceedings of the Engineers' Club, of Philadelphia.

rate the material no higher than scrap, as it is very questionable whether it would bring a higher return if sold.

As the material for producing the items under this head has been entered as a charge, its value should be credited to the total costs in order to give a true net total cost.

(*j*) Light: All charges directly connected with the shop lighting.

It is to be remembered that the divisions as here cited are merely suggestive of underlying ideas and principles; in actual practice a larger number will be used, and many will be divided and subdivided. The labor charge, for instance, should be split up into direct and indirect labor, etc.

In general it will be most convenient to reduce all elements to a basis of cost per 200 pounds, or one-tenth ton, as a compromise that avoids the high figures for output when figured in pounds and yet allows ready reduction to the pound rate generally used in the sale of castings.

In comparing costs at different periods it will not do simply to divide the total cost incurred during a week by the total pounds produced during that week and take the result as a pound cost, to be compared with that of some other period. Every manager knows that the cost per pound rises when the product is small and decreases with an increasing output, and will take this into account when comparing costs. But such allowance is made as a matter of judgment only. Now, judgment is a very good thing, but certainty is still better if it can be made to take the place of judgment; in this particular instance that can be done and quite readily. As an example, say that the fixed general expense charge for a week is $1,600; with the output 50 tons, the charge per 200 pounds is then $0.80; but for a doubled output of 100 tons the charge per 200 pounds would be halved to $0.40. These values, plotted as a curve for various rates of output on the horizontal scale, give the diagram Fig. 1.

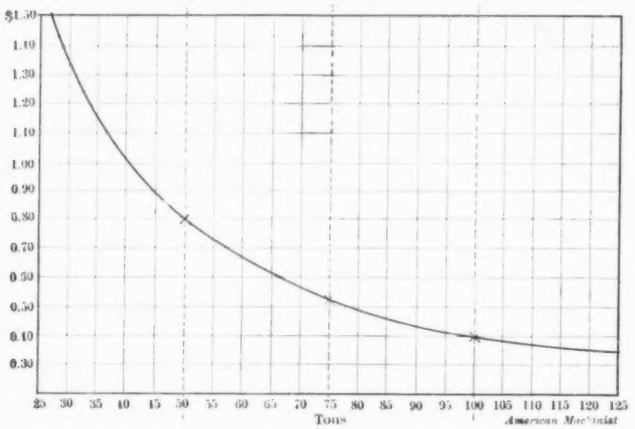


FIG. 1. GENERAL EXPENSE.

Similarly, that other element of fixed cost, fixed salaries, is plotted as Fig. 2.

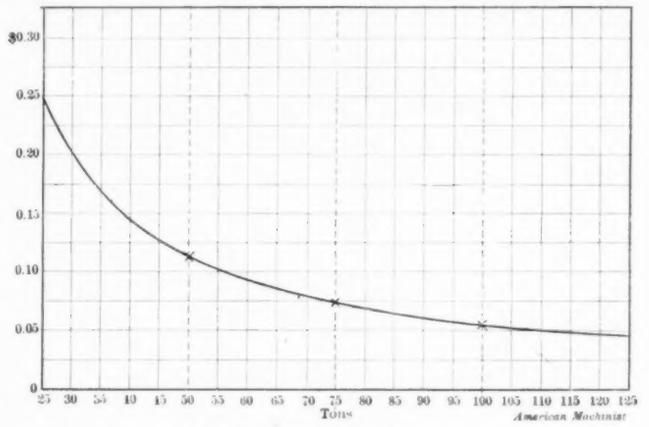


FIG. 2. FIXED SALARIES.

Fluctuating elements of cost are also so plotted, though from the nature of the case the curves cannot be determined by direct calculation, but must be approximately laid down in accordance with experience and judgment. In this way the diagrams for power (Fig. 3), for miscellaneous materials (Fig. 4), and for labor (Fig. 5) are laid down as decreasing with an increase in production. Pig and other charging metal (Fig. 6) and smelting material (Fig. 7) are laid down as horizontal lines, as these items are not apt to be materially affected by the amount of the output.

All of these curves or lines I term ideal curves. Their total will give an ideal total cost of production, as shown in diagram Fig. 8, by the lower line, per 200 pounds of melted iron. If all the iron melted were turned into salable castings, this lower, or 100 per cent., curve would represent also the cost of salable castings. The other curves give the cost of salable castings for the various ratios of such castings to the total iron melted. These curves are determined as follows: Take the total cost per 200 pounds of melted iron as $3.40, the value of recovered iron as $0.20, the salable castings as 80 per cent. Then the 160 pounds of salable castings would cost as much to produce as the 200 pounds of iron melted, less the value of the recovered iron, *i. e.*:

Cost of melted iron	$3.40
Value of recovered iron	0.20
Cost of the 80 per cent. of salable castings is the balance	$3.20

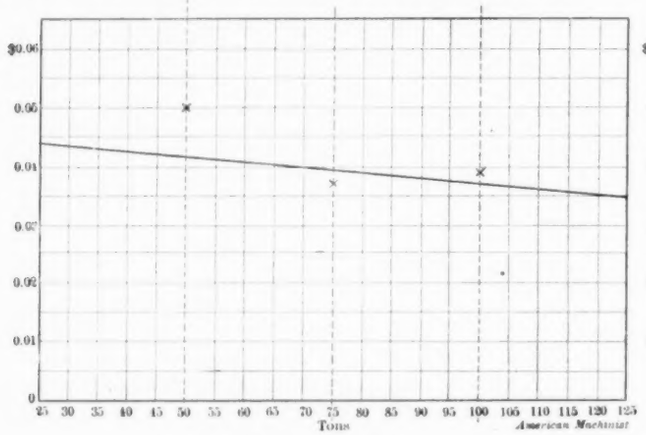


FIG. 3. POWER.

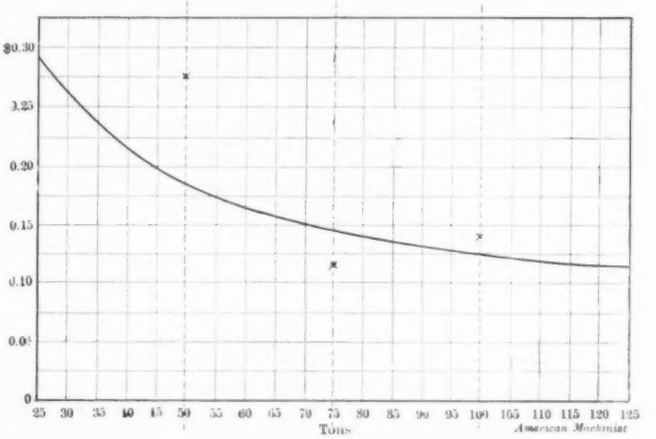


FIG. 4. MISCELLANEOUS MATERIALS.

and 200 pounds of salable castings would cost $\frac{3.20}{0.8} = \$4.00$.

This can also be put as a figure to be added to the cost of the melted iron from the equation:

$$s = \frac{1}{p} - 1\ (i - r),$$

in which

s is increase to be added to cost of melted iron to give cost of salable castings;

p is percentage of salable castings divided by 100;
i is value of melted iron;
r is value of recovered iron.

Considering in illustration values from Fig. 8: The actual cost per 200 pounds of melted iron is $3.73, $3.09 and $3 in the three periods shown. According to the ideal curve, the lower one marked 100 per cent., these costs should have been $3.40, $3.07 and $2.90. Running up the first week's cost, the manager finds that of the various items the cost for miscellaneous materials (Fig. 4) was by far the higher as compared with the ideal laid down, and instructed the foreman to cut this. Next week the total is still found too high; following this through shows that miscellaneous material cost has been reduced actually below the ideal, but that the labor element (Fig. 5) went up materially; investigation in the foundry showed that the foreman economized on sand mixtures and facings to such an extent as to apparently increase the cleaning labor; the apparent relation between these two elements of cost should be followed up to see whether it is actual. The best way is by a further subdivision of these two elements for some time. As before stated, the analysis is here carried only far enough to explain the idea; nor must the figures given be considered in any other sense.

The following week the total is still found high as compared with the ideal, but more nearly satisfactory.

Looking further, the manager finds that the cost of the salable castings is $4.41, $4.90 and $3.28 in the respective periods (entered as + points in the diagram), whereas they should have been but $4, $4.44 and $3.08, to correspond with the ratios of 80, 60 and 90 per cent. of salable castings. The very low ratio (60 per cent.) of salable castings in the second week is entirely too poor a showing to pass without comment. Tracing upward, it is found that the smelting cost (Fig. 7) was very low, leading to the inference that economy of fuel had led to the very large amount of wasters; investigation in the foundry bore this out, as too dull iron, consequent on the use of insufficient coke, caused a lot of scrapping.

From what has been said it is apparent that this plan of plotting records and methods of analysis based on comparison with ideal conditions keeps the busy manager up to date in his knowledge of what is actually going on, not only as regards totals, but also in detail, so that he is always in position to find a sore spot and apply a remedy based on certain knowledge, backing up his judgment. The method has the further advantage of showing whether the remedy applied really did result in the cure desired or whether it merely brought about a transfer of the sore to some other place.

Knowledge of the fact of such close analysis being made will keep the foreman and others responsible tuned up to concert pitch. It has, in my experience, immediately on adoption resulted in a decrease in costs; showing the foremen actual figures will avoid much of the bad feeling easily raised with well-meaning men when their results are criticised. Being human, they are more or less inclined to ascribe criticism to prejudice. Under this method of absolute analysis responsibility will be placed where it belongs, and it will be possible to bestow praise judiciously in the proper quarter—the old adage to the contrary notwithstanding; "soft words do butter parsnips," to the decided advantage of the firm.

In enumerating the elements of cost, mention was made of a market equalizer

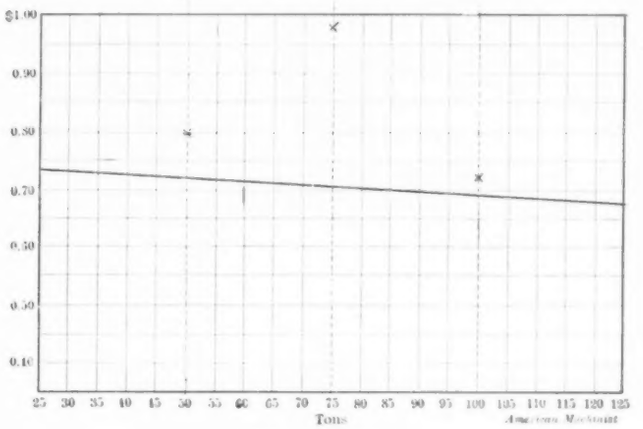


FIG. 5. LABOR.

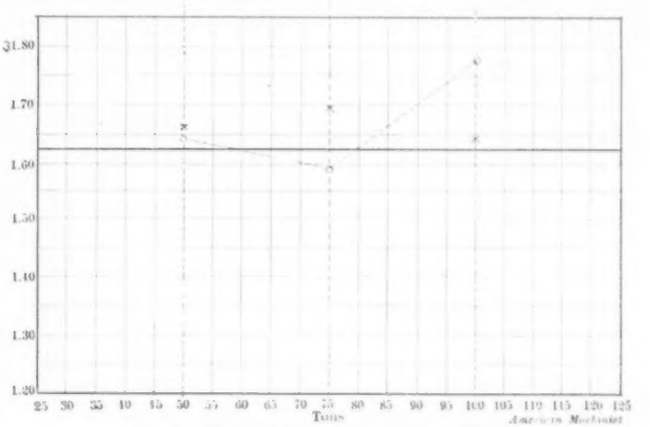


FIG. 6. PIG AND OTHER CHARGING METAL.

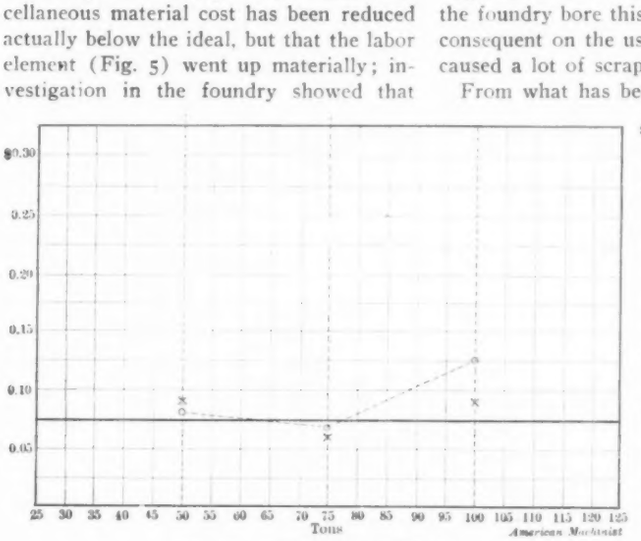


FIG. 7. SMELTING MATERIALS.

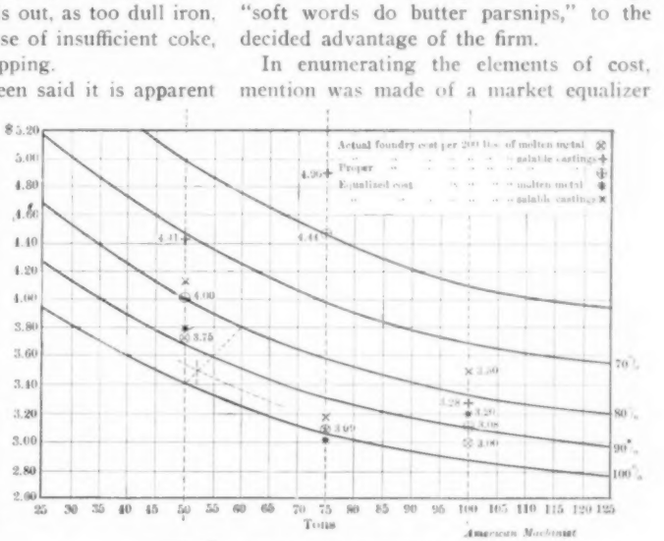

Actual foundry cost per 200 lbs. of melted metal
Proper " " " salable castings
Equalized cost " " melted metal
" " " salable castings
Tons
American Machinist

FIG. 8. TOTAL COST OF PRODUCTION.

that the equalizer to take into account the fluctuating value of the materials bought; this is brought in as follows: The actual unit value of material used at any time is its average cost price; this may, according to circumstances, be either higher or lower than that due to the current market rate or than the ideal assumed. These actual costs of such material are plotted into Figs. 6 and 7 with the sign O. The actual total costs as modified by the equalizer are also added on the total diagram (Fig.

8) with the signs * and ×. Consulting this, it will be seen that a recent purchase of pig and coke at high figures had the effect of raising the cost of the last week's output considerably—from $3 to $3.20 per 200 pounds of molten metal and from $3.28 to $3.50 for salable castings. The actual utility of separately considering this element is evident, as otherwise the more nearly satisfactory cost of production, so far as under the control of the foundry foreman, would have been obscured. The actual cost due to the market price of the materials being given will allow sales being based on that.

Lighting has not so far been taken into account as an element of cost; this because it is dependent upon the season and the weather, conditions that are not subject to control. This variable character would to a certain extent impair the value

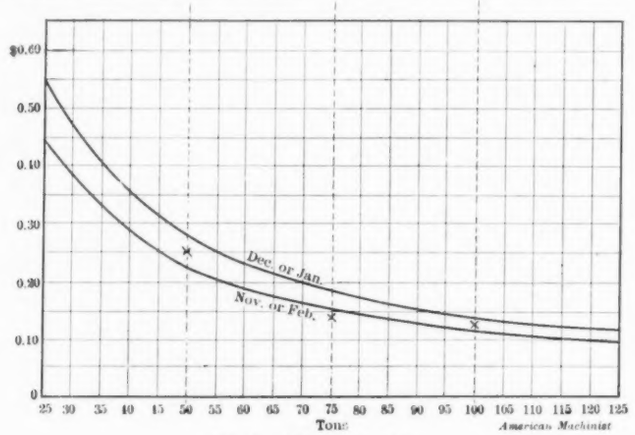


FIG. 9. LIGHTING COST.

and reliability of the main analysis for purposes of cost comparison. I therefore prefer to plot it as an addendum diagram Fig. 9, and to consider its influence on costs separately. In determining sales prices this cost item must of course be added.

The totaling diagram, Fig. 8, would be too greatly obscured were curves drawn in for more than each 10 per cent. of variation of salable castings. It is, however, a very simple matter to interpolate points as desired; say the 95 per cent. line is required at about 60 tons output. Mark the intersection of any vertical in that neighborhood—say 50 with the 100 per cent. curve—then the intersection of the next heavy vertical at 10 tons farther along with the 80 per cent. curve; then of the next heavy vertical at 70 tons with the 60 per cent. curve; now pencil a curve through these intersections. As 95 is midway between 100 and 90, the intersection of the curve just penciled in with the vertical midway between those cutting the 100 and 90 per cent. curves will be a point on the 95 per cent. curve sought. This latter may then be continued both ways approximately parallel to the curves between which it lies.

In conclusion, I may be permitted to point out that this method of cost analysis is not by any means restricted to the foundry, but is applicable advantageously to all lines of work in which the cost of production varies necessarily with some other factor; in most lines of manufacture that factor would be the output. Although rather lengthy to describe, the plan is not at all formidable in actual use. All the data required are assumed as available, being needed for any arrangement of recording costs that may be in use, so that there remains only the work of laying down ideal curves and of plotting in the actual values; this latter operation is a very simple one that can be quickly mastered by the average costing clerk.

Note.—These diagrams should in practice be so bound together that the dotted lines run continuously over the entire series; that will permit a ready tracing of each period's output to the various elements. Plotting books as used by engineers will be found very useful for entering the diagrams.

A Rock Drilling Contest.

There is to be a mining carnival at El Paso, Texas, next November during which there will be a rock-drilling contest for which prizes are offered aggregating $6,000. There have been many of these contests and they have been conducted with exceptional fairness and honesty, but they are always more or less unsatisfactory from the difficulty of discriminating between the qualities of the drill and the skill of the operator. The *Mining Reporter* very properly suggests that in such a contest there should also be some recognition of the drill sharpeners, or the blacksmiths who keep up the drills. Besides these, and especially after the revelations and experiences of the past year or two, the steel makers may be claiming that they also have a right to go on the record, so that while the contest may show many things there will be quite a time in sorting them out to the satisfaction and glorification of all the parties interested. As establishing records of what can be done in rock drilling the contest is all right, no matter how the records may be made.

Clearance Allowances in Rough Castings.

BY JOSEPH HORNER.

In the shops one learns, largely by experiences of blunders, what clearances are necessary between certain parts of castings, why there should be more in some cases and less in others, and what conditions determine the differences in the amounts allowed. It is seldom that a hard and fast rule can be formulated, but experience is the sure guide; and there is scarcely any line of engineers' work in which the question of clearance in some form or other does not arise.

One of the commonest cases is that of "black" bolts and their holes. Drilling holes through a considerable depth of solid metal is more costly than coring them, cases of special work and special machines excepted, hence the reason why cored holes are often used in preference to black, or perhaps turned bolts in drilled holes. The general objection to cored holes is that in consequence of the inaccuracy inseparable from such work, it is impossible to make the same close fit of the bolts in the holes, and therefore the holes must be made larger in diameter than the bolts, by the amount of inaccuracy excepted. How much this will be depends on several circumstances, so that the clearance may vary between 1-32 and ⅛ inch, or even more. This means slop fitting, which is objectionable in parts that are subject to much vibration and stress, which includes all engine and good machine work. Where there are a large number of bolts even the evil of possible slipping and sliding of surfaces is somewhat neutralized, because the friction due to the tightening of the bolts is very considerable; and, further, the bolts to some extent will tie one another in their holes, pressing hard against the sides of the holes, some to one side and some to the other, instead of passing through the center, with equal clearance all around. There is, however, a larger volume of such work done than men accustomed to the methods of machine tool establishments, which are but one branch of engineering practice, would suspect. It is found especially in contractors' and builders' plants, in parts of cheap cranes and hoisting machinery, and in other classes of machinery which are made cheaply, in columns and pipes and much besides, and it is in these that the question of clearances in cored holes becomes of much importance.

When deciding on the amount of clearance to be given in cored holes, two points at least have to be considered. One is the length of the core, and the other is its direction. Thus it is easier to core a short hole true than a long one, and to ensure the accuracy of a core set vertically in a mold than that of one laid either horizontally or obliquely. The accuracy of a short core set vertically and stayed with a top print may be depended on, and then

a slight allowance for clearance will suffice. But even then the core-box must be quite correctly made to size and shape and the prints carefully fixed, and the molder must be careful to insert the cores accurately. Under these most favorable circumstances, therefore, from 1-32 to 1-16 inch represents the clearance allowance which can be given in a short, rough-cored hole with the core set vertically.

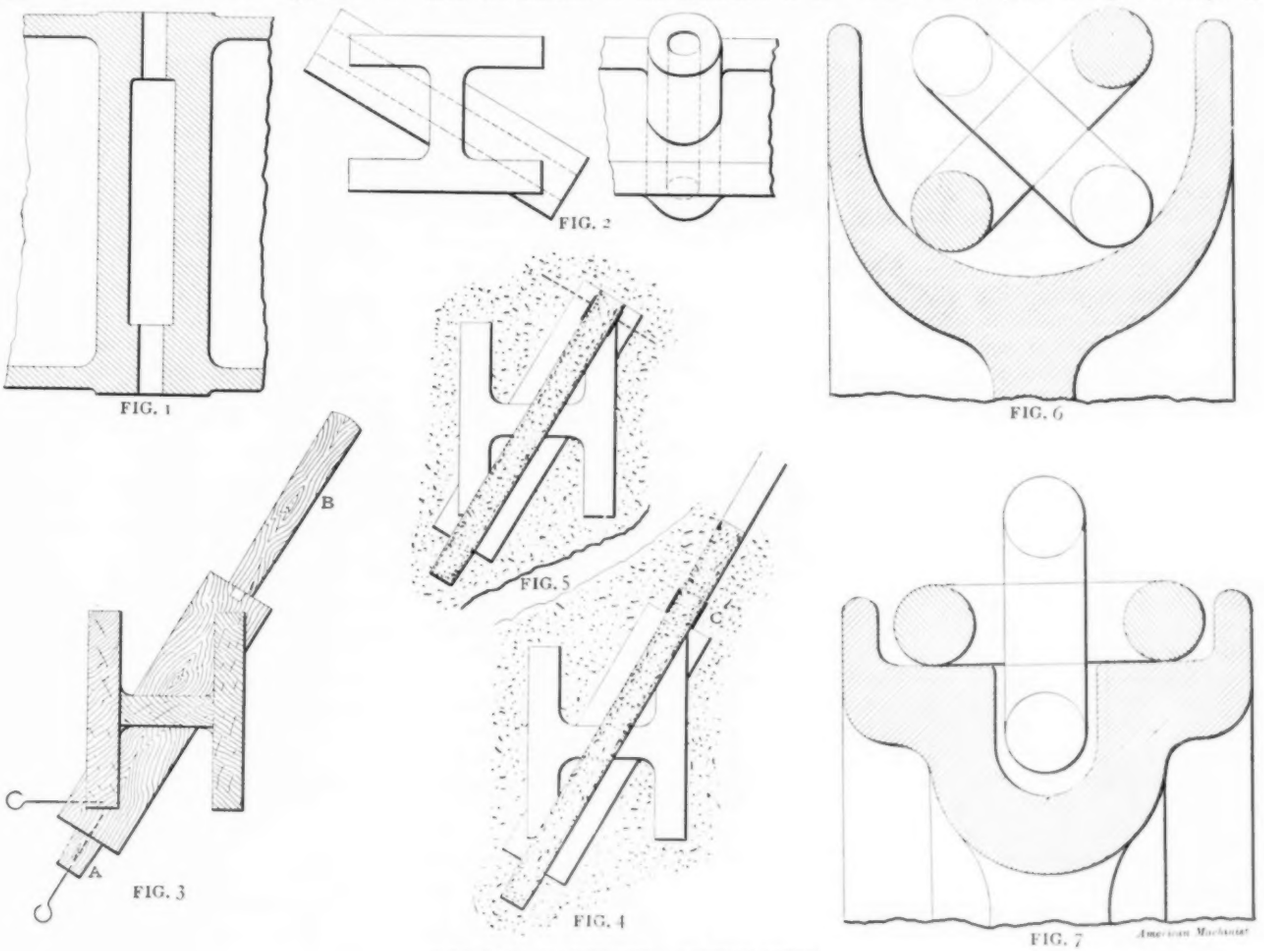
When the cores exceed 3 or 4 inches in length, the allowance must be increased to from 3-32 to ⅛ inch, cores from 4 to 5 inches long would need ⅛ inch to compensate for inaccuracy of fixing, and when 5 or 6 inches are exceeded cores of small diameter cannot be depended on with even ⅛ inch of clearance, not only because of probable inaccurate setting, but from the liability of the core to be bent by the flow or pressure of the liquid metal. A long core from ¾ to 1½ inches diameter will often be bent or curved to an extent greater than the amount of clearance allowed, say from ⅛ to ¼ inch, and this means putting in a smaller bolt than was originally intended or else reaming out the rough hole. Always, therefore, in cases of long, slender cores the holes should either be given a large amount of clearance, or, preferably, they should be chambered (Fig. 1). The chamber may extend nearly to the end, and the diameter of the enlarged portion need not be much greater than that of the clearance hole. If the core then becomes bent by the liquid pressure it will be of no consequence, because the bending will not affect appreciably the short lengths of the actual clearance holes at the ends.

When holes are cored in horizontal positions there is a general probability of greater inaccuracy, due to both the setting of the core and its bending, than when they are placed vertically. A horizontal core is almost always placed in pocket prints, and if the diameter of the core does not quite correspond with the semi-diameter of the lower portion of the print, then the amount of the difference is always on the top side, and the core is set out of truth by that amount. During the stopping over, the core will often become moved slightly in the print by reason of the sand having been broken and mended up again or pressed and pushed slightly out of place. The only way to ensure accuracy in cores set in drop prints is to make a special core-box which will stop the core off—*i. e.*, fill up the print impressions over the core, as well as core the actual hole, and to see that dimensions of print and core coincide exactly, so leaving nothing to the molder beyond the insertion of the core.

Another point is, that horizontal cores of considerable length are much more liable than vertical cores to be curved lengthwise by the liquid pressure, the curving being upwards, and therefore there is more reason why these should be chambered than why cores set vertically should be so treated.

Cores which lie obliquely are the most difficult to set and keep true, because, as a rule, no top print can be employed to steady them, or when employed it is an awkward device. Fig. 2 is one of the tie-rod bosses in a crane girder. The core may be carried wholly by the bottom print *A*, Fig. 3, tho it is sometimes practicable, if the molding box will permit of it, to bring a stay print *B* right through the cope and thrust the core through it into *A*, allowing the upper end of the core to remain in *B*, by which it will be kept central, Fig. 4. It is common practice to ram an iron ring around the stay print, to prevent the insertion of the core from pushing down the sand. This ring is seen at *C* in Fig. 4.

Objections to this method are the awkwardness of bringing stay prints out through the top box, and the risk of pushing down the sand by the thrusting in of the core. Hence the more general way is to set oblique cores by the bottom print only, and center them at the upper part with chaplet nails, Fig. 5. Hence in such



CLEARANCE ALLOWANCES—HOLDING CORES.

cores it is always necessary to allow a wider margin of clearances in the holes than when cores are set either vertically or horizontally. This is generally ¼ inch, seldom less than 3-16 inch. I have seen such holes reamed out because a draftsman had figured only ⅛ inch clearance in them. Even with 3-16 inch clearance it is desirable when the holes exceed 8 or 10 inches in length to chamber them as well.

To lessen the cost of drilling deep holes an alternative method is to core holes below size and drill or ream them afterwards. The objection to this is that the rough skin of the casting punishes the drill so severely. The plan is often adopted nevertheless and effects a considerable saving in time. To still further lessen the cost, such deep holes are often chambered so that the end portions only, beyond the chamber, have to be reamed out. This is a frequent practice in the case of holes cored through deep hold-down bosses in the bed plates of cranes, and similar heavy castings, and in the bosses through which bolts pass into standards, and in cases of other holes of over 4 or 5 inches in depth.

Still another method by which some saving in drilling is effected is to have some holes in the same casting black and some drilled, fitting turned bolts to the latter. This is secure and safe when the number of bolts passing through a structure is large. Turned bolts may be used, say, at four corners, or down two sides of a frame and black bolts elsewhere. It is not worth while doing this in thin plates and flanges, but when the bolts have to pass through from 3 to 5 inches of metal the saving in cost is worth effecting. All these considerations must be remembered when noting on drawings the clearances in bolt holes.

Another class of clearances is that for chains for cranes and hoisting machinery generally. The clearances for the chains in sheave wheels should range from ⅛ to ¼ inch more than the width of the links. Usually the chain links ride diagonally, Fig. 6, but the width of the chain in the clear must be given on the supposition that the links may ride flatwise, which is done in Fig. 6, which they sometimes must do owing to the twisting of the chain. The flanges of many sheaves have broken because insufficient allowance has been made between the flanges. When a chain lies flatwise, clearance must be left between its links and the groove, Fig. 7.

In many lines of work it is necessary to make clearances to allow for the roughnesses on, and the thickening or "gathering" that occurs in castings. Unless special allowances are given for these there is unnecessary and extra work involved in machining or fitting. Thus the eyes of tension rods in roof and crane structures should always be made a slack fit on their bosses or pins. It is useless to figure the hole of a black eye and the diameter of a black pin to the same dimensions on a drawing, for if so they will never fit. The hole in the eye should always be figured 1-16 inch, or in some cases ⅛ inch, larger than the pin to ensure a free fit. Sometimes tie rods pass over cast-iron bosses, and then quite ⅛ inch difference must be made to compensate for the taper of the boss and the rapping in the sand. So in black split cotters and punched and drifted or cored cotter ways, the ways must be figured 1-16 inch larger than the cotters if these are to go in without fitting or grinding. A slight amount of filing on the top edge is of course necessary, to obtain the proper driving fit.

Almost invariably, both in cast and in forged work, dimensions come out large or full. One reason is that smiths are always afraid of getting work under size. As they say, you can take off, but you can't put on; and so, keeping on the safe side, they generally turn out all dimensions slightly oversize. In cast work the same practice almost invariably exists. The patternmaker keeps on the right side, and mostly allows the normal amount for shrinkage without considering those cases where the shrinkage will probably be less than the normal. The molder does not spare the rapping bar and hammer, for he desires a free delivery. And, lastly, metal is almost sure to increase in thickness over and above that given by the pattern, and even by the mold, more in green sand than in dry, more on flat horizontal surfaces than on vertical, more over large areas than small ones. And of a number of castings molded from the same pattern, by the same man, no two will come precisely alike, unless they are machine molded and poured with similar metal. Castings molded from the same pattern by different men will generally show more marked differences. All these matters ought to be considered when deciding on the clearances in given cases.

The evil becomes magnified when there is a succession of castings superimposed or placed end to end. Thus, in making a number of elevator screws to thread end to end on a square shaft, I have found it necessary to include the end faces of the castings in the core forming the central square hole, in order to have the ends true and the castings of equal length throughout the set. And this reminds us how fruitful a source of inaccuracy molders are, for the joints not only often overlap, but the tapering away of the mold from the bottom upwards to the joints causes a more or less convex face on the castings, a somewhat indeterminate amount, frequently, however, as much as ⅛ inch or more in large molds. This is one reason why the old chipping strips are retained in some cases, not always that the fitting is required to be so nice that chipped or planed faces are really necessary, but just because of the "gathering," or increasing in dimensions, which takes place due to the aforesaid causes, and, second, because lumpy faces cannot be made true and brought up close without involving a large amount of unnecessary labor and expense, whereas if there are strips it does not matter so much if the general surface of a casting is lumpy, since a little material removed from the higher parts of the strips will bring the parts to a true bearing.

The clearances of the teeth of wheels seem rather outside of this subject, because their amounts have long been fixed by custom. But these clearances are often in excess of what they need be. It must be remembered that they were fixed at a period when there were no wheel molding machines. One of the chief advantages of these machines lies in the accuracy and uniformity of their work. With wheels made on these, there is no reason why the amounts of flank and root clearance for wheels as molded from patterns should not be diminished by one-half. For steel wheels the clearances could not be diminished at all, because these almost always come out inaccurate; in some cases large wheels of 5 or 6 feet diameter will be out of truth in respect of the circular form ½ inch, and ¼ or ⅜ inch out in the plane of the face, besides which the teeth are often lumpy and not uniform. In gearing the ideal wheels are those which are machine cut, with practically no flank clearance. There is no reason why well-molded iron wheels, molded by machine, should not approach more nearly to this condition than they do, when high-class work is desired.

Making Oven Racks.

BY CARROLL ASHLEY.

The drawings show a set of combination dies to make oven-racks of three different sizes. Fig. 1 shows the first operation, that of forming the sides. It should be understood that the blanks are first cut to size on the square shears. The material is 24 or 26 gage soft stock.

Fig. 2 gives a good idea of the dies for bending the ends of the 3-16 inch wires at right angles. This set of dies is made to bend a complete set of wires needed for one rack. It will be seen by referring to Fig. 4 that in every rack one wire is not bent at the ends; so if the rack is to be of ten wires, this set of dies will be for nine wires only, the wires of course being first cut off to the right length.

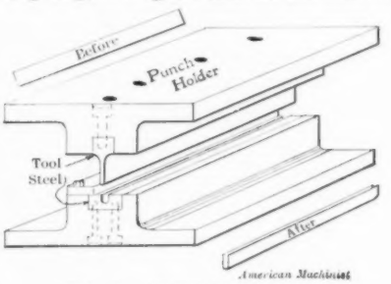


FIG. 1. U-ING THE SIDES.

The gray-iron plate, shown at *A*, Fig. 2, acts as a stripper and also as a gage in the placing of the wires in the die. It is grooved just half the thickness of the wire, and the grooves exactly match the

grooves at the ends. The tool-steel pieces *B B* are tongued into the punch-plate and are held thereto by filister head screws. They are wide enough to lap over each end of the gray-iron stripper. These pieces are also grooved on their working faces exactly the same distance apart as the grooves in the lower die. *G G* are gage-plates. The tool-steel pieces at each end of the lower die are fastened to the gray-iron pieces *H H* by filister head screws and dowel pins.

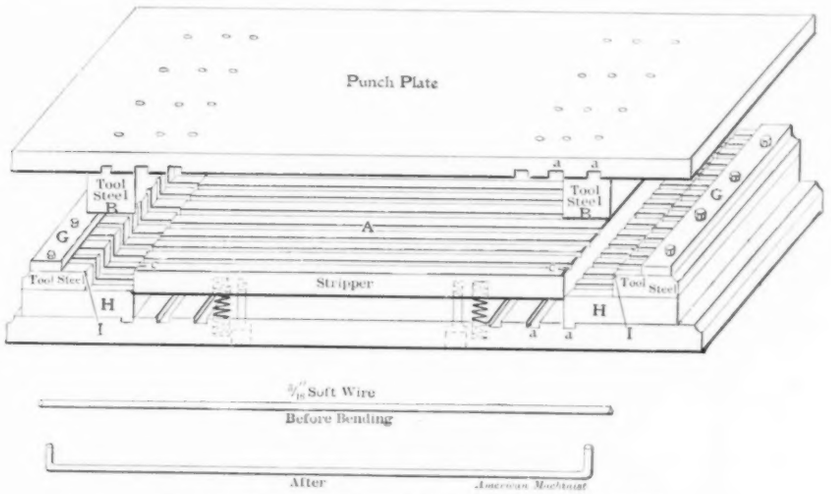


FIG. 2. COMBINATION DIE FOR BENDING ENDS OF WIRES.

This set of dies is constructed to make three different lengths of wires; by putting more splines *a a* in the upper and lower plates, still more lengths can be made. The drawing shows grooves for fourteen wires in Fig. 2, which is five more than needed for this identical rack; but some stove builders prefer to have this operation performed in this manner.

In action, the wires first being laid in their respective places, the press is tripped, and the punch-pieces *B B* strike the wires at the points marked *C C*, and just inside the shoulders *I* on the tool-steel pieces in lower die. Passing on down the stripper *A* is forced down until punch-pieces *B B* bottom on the gray-iron pieces *H H*. On the return stroke *A* follows the punch upward, thus forcing the bent wires free, when they can be brushed off to the back of the press. *A* is made in three different lengths, to accommodate the three different combinations of the other parts. This is sometimes called a floating pad; it is held in position by screws from under the lower die-plate, as shown, and a number of coil-springs normally keep it up in its position. This wire-bending might possibly seem to be a slow and tedious operation, but in practise it is not.

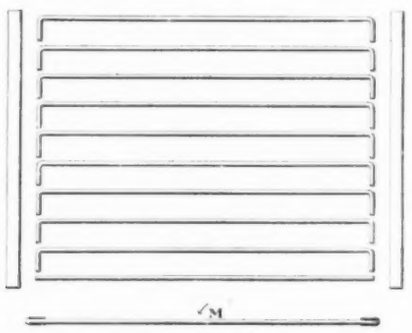


FIG. 4. SHOWING HOW THE WIRES AND SIDES GO TOGETHER.

Fig. 3 shows the dies for the final operation, the completed rack as turned out being seen in Fig. 5. There is a similarity of construction shown in Figs. 2 and 3, inasmuch as the upper and lower plates are of the same thickness. While the operations are quite different, the general perspective of the dies is the same. In Fig. 2 the stripper *A* is made to fill the entire opening, so as to keep the wires straight; in Fig. 3 there is no need of such a stripper, as the pressure is not exerted on the wires but on the end pieces, so a machinery-steel stripper is provided for each end, about 1 inch wide, grooved crosswise for the wires and arranged to act on springs while held in place by screws, both from the underside. When at its highest position, it rests below the top of pieces *J*, the thickness of the end piece. The wires and the two end pieces are placed in this die, as at *M*, Fig. 4. I believe that a careful study of the drawings will give an insight into their construction and operation.

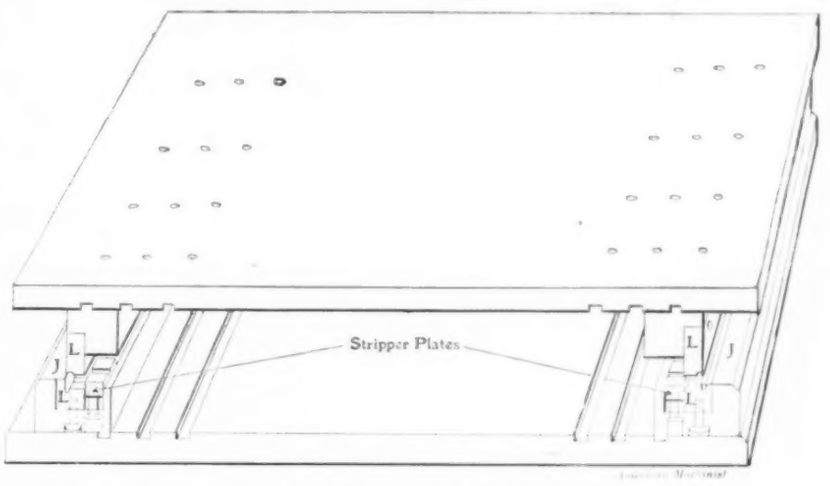


FIG. 3. DIE FOR CRIMPING THE SIDES ON TO THE WIRES.

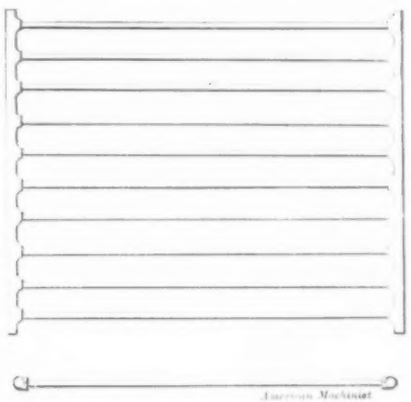


FIG. 5. OVEN-RACK FINISHED.

To machine these sets of dies and have every slot and spline in perfect alinement is a very good job of planer and shaper work. I have seen several sets constructed and know whereof I speak.

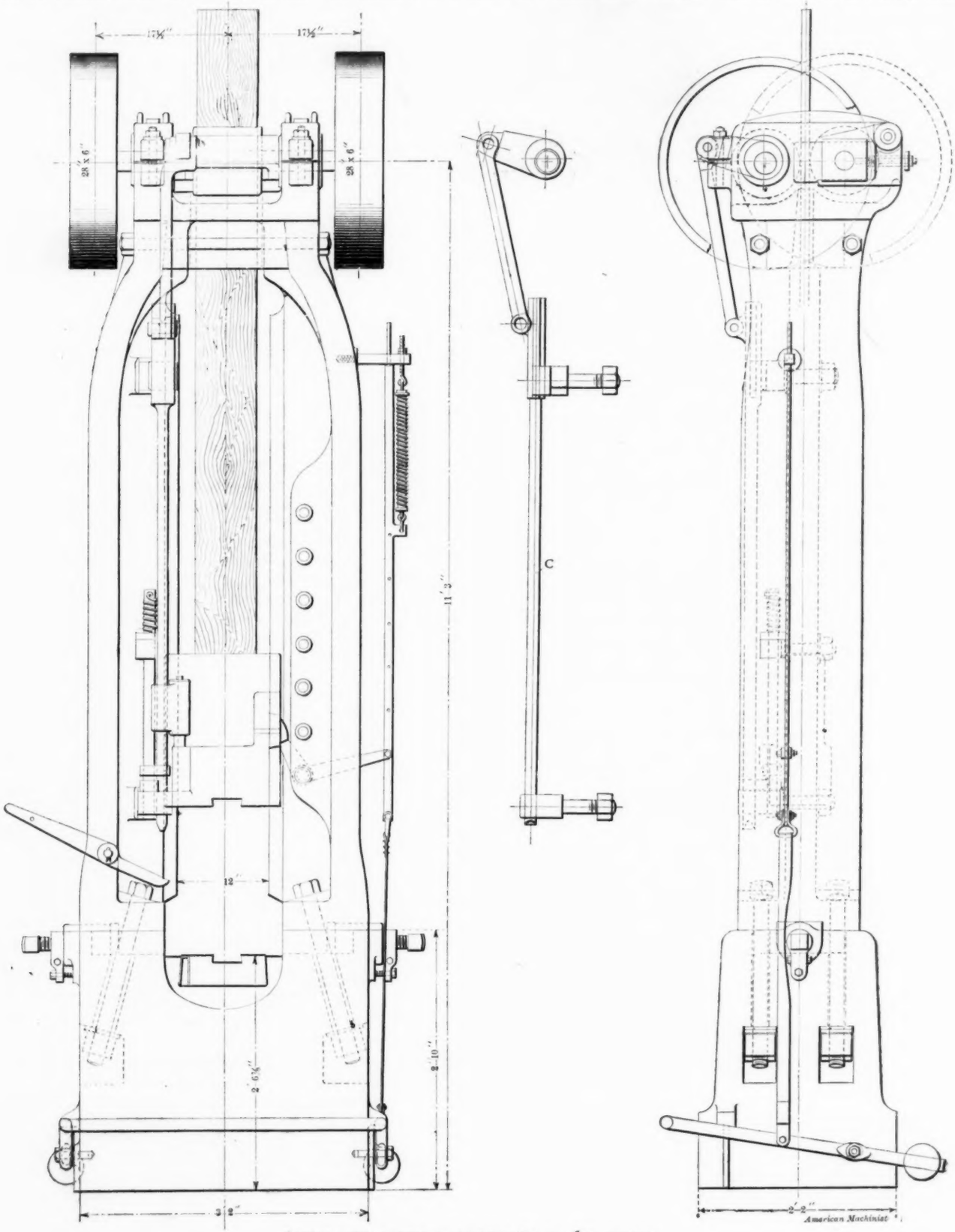
Rochester, N. Y.

Process for Annealing Steel.

A recent patent for annealing steel provides for heating it in a bath of melted aluminum. The melting point of aluminum is said to be very near the proper heat for the purpose, so the temperature of the metal is allowed to rise only a little above the melting point and the steel to be annealed is simply submerged in it until it uniformly attains the same temperature. The loss of metal if not overheated is said to be slight and its action upon the steel is claimed to be entirely beneficial, not only preventing the formation of scale, but tending to remove scale already formed. The patent referred to, altho entitled "a process for annealing steel," very curiously has nothing to say about the cooling of the steel after it has been thus heated.

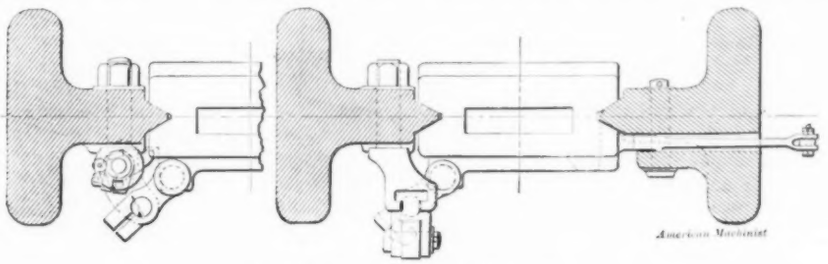
The Ambler Drop Hammer.

The endurance of drop-hammer dies and the quality of the work turned out by them depend very much of course upon the hammer with which the work is done. We illustrate herewith a hammer designed by A. A. Ambler, who for many years has made a specialty of drop-hammer work in connection with various manufacturing concerns, and is now superintendent of the Foos Manufacturing Company, of Springfield, Ohio, builders of the hammer. The company sends us photographs of one of the hammers as it stands in a smith shop, but these are illy adapted for reproduction and the hammer is better shown by the two views in Fig. 1, which is made from drawings. It will here be seen that the method of fastening the housings to the anvil block is unusual, two bolts passing through each at an angle as shown, these



THE AMBLER DROP HAMMER—400 TO 600 POUNDS.

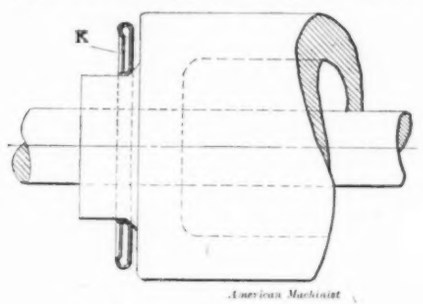
tending not only to keep the housings firmly seated within the recess in the block but also firmly against the adjusting screws by means of which the guides are adjusted to proper position. It will be noticed that



DETAILS OF AMBLER DROP HAMMER.

there are locks for these screws that prevent them being disturbed by the shocks. This is shown more fully by Fig. 2. At the top the housings are attached to the crosspiece by through bolts and are seated to what really constitutes a dovetail; locking all together very firmly, the surfaces here are about 18 inches wide and the bolts have elastic washers under the heads and nuts. This also is shown in Fig. 2.

The drop rod *C* (shown separately by Fig. 1) is jointed and operates the eccentric positively, as it is always kept vertical. *D* is the automatic trip rod with a steel latch *E* keyed to it and tripping dog *F*, adjusting collar *G* and torsional spring *H* by which it is seen that when the hammer head drops the wedge-shape portion *I* engages with the dog *F*, turning the trip rod



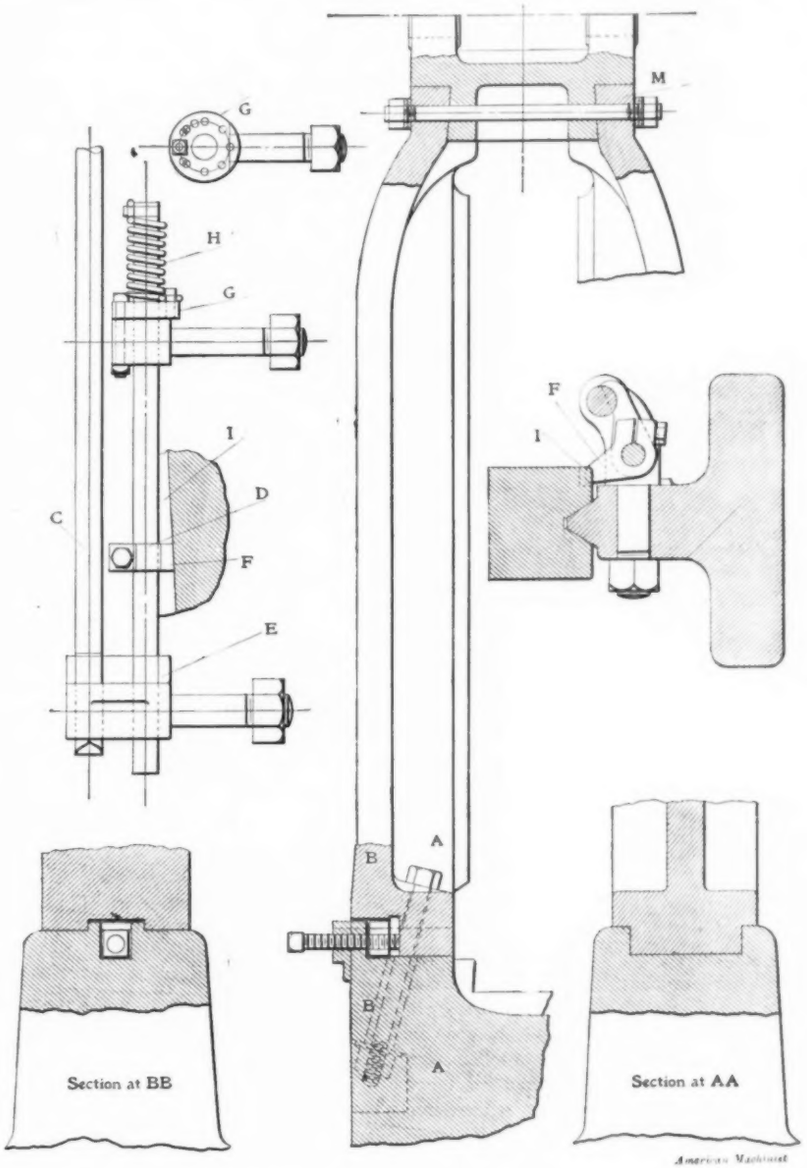
OIL RETAINING DEVICE FOR ROLLS.

and latch sufficiently to release the drop rod so it can fall. By means of the torsional spring *H* the trip rod *D* is made very flexible and sensitive at the top and by means of the vernier spacing of the holes in the adjusting collar *G* almost any flexure of the trip rod *D* is obtained. The tripping dog *F* is adjustable vertically on the trip rod, thus enabling the trip to be made at the most advantageous points whether the dies in use are high or low.

There is also an improved cushion bumper for the drop rod which has proven by extensive tests to give a positive but easy action to the rod, entirely avoiding levers and similar complications. This construction requires no more attention in changing from a high to a low stroke than if the bumper were made of a solid-steel block.

It is recognized that in all friction roll hammers perfect control of the action of the hammer can be obtained through the lifting board only when it is entirely free from foreign substances, especially oil. In recognition of this fact the hammer under consideration is provided with a special device for avoiding trouble from this source. The bearings all have chambers holding the oil in check until required for lubrication, and in case any of it should escape it is forced to the end of the roll and by the centrifugal force to the cavity *L*, Fig. 3, which is filled with wool or other absorbent material and there retained, thus preventing it from ever reaching the working surface of the roll or getting on to the board. A portion of the trouble with hammer boards is found to result from the fact that they are subjected to an excess of heat upon one side coming from the furnace. In this hammer the board is so keyed into the hammer proper that it can be reversed, side for side and end for end, thus equalizing all conditions and wear.

These hammers are all designed upon a general ratio of 15 to 1 with reference to the weight of anvil and hammer head and in service, some of which has been especially severe and exacting, as, for instance, in the Springfield works of the International Harvester Company, where a hammer is in use placed within an inch of the natural bed rock, they have stood up well and have retained their adjustments satisfactorily.



DETAILS OF AMBLER DROP HAMMER.

The Westinghouse Electric & Mfg. Co.'s Abandonment of Wire and Sheet Metal Gages.

Last week we referred to the fact that the Westinghouse Electric & Manufacturing Company had abandoned all use of gage numbers in referring to wire, sheet metal, etc. We give herewith some extracts from their pamphlet and reproductions of tables adopted by them. In the pamphlet referred to the company says that it will abandon the use of all wire and sheet-metal gages in favor of decimal dimensions and will measure with micrometer, or with limit gages all materials that have hitherto been identified by gage numbers and commercial gaging.

The company has been led to this adoption of a uniform system by the confusion that has arisen from the use of some ten or more different gage systems for identifying different materials.

INDEX to COLUMNS 1 to 10		Br. Cp.	Br. S.	Ph. Bz. W.I.	Ger. Sil. Ld.	Alloy Aln.	Pl. Zn.	Amer. Screw Gauge
SHEET & PLATE	Commercial	1 1	5	1 5	1	1 1	6	000 .0315
	Planished		5	5				00 .0447
	Galvanized		5	5				0 .0578
	Tinned		5	5				1 .0710
	Terne		5					2 .0842
	Spring		2 1					3 .0973
WIRE	Bare	1 1	3	1 3	1	1 1		4 .110
	Insulated	1				1		5 .124
	Galvanized		3	3				6 .137
	Tinned *		3					7 .150
	Spring		1 3	1				8 .163
	Music		4					9 .176
	Resistance			1	1	1		10 .189
	Annealed		3	3				11 .203
ROD	Commercial	1 1				1		12 .216
	Cold Rolled	1 1	8◊					13 .229
	Drill		8					14 .242
TUBE	Seamless ⊗	2 2	2	2		2		15 .255
	Brazed		1					16 .268
								17 .282
								18 .295
								19 .308
Twist Drills: 9. Coppered Steel Wire: 3. All cable, lamp cord and fuse wire: 1.								20 .321
								21 .334
								22 .347
◊ ⅛ dia. up can be had in fractions. △ 1" dia. and larger, in fractions. ⊗ All seamless tubing may be specified by diameters instead of thickness of wall. * Tinned steel banding wire, special diameters.								23 .361
								24 .374
								25 .387
								26 .400
EXPLANATORY. With the exception of Twist Drills, the following "Instructions to Draftsmen" do not affect finished articles such as are known to the trade by gauge numbers. For example: Machine & wood screws will continue to be specified by the American screw gauge numbers.								27 .413
								28 .426
								29 .439
								30 .453
INSTRUCTIONS TO DRAFTSMEN. When specifying material of "gauge" thickness, do NOT give gauge name or number, but specify in decimals, thus: .036 Sheet copper .162 Brass rod								31 .466
								32 .479
								33 .492
								34 .505

TABLE 1. INDEX TO COLUMN HEADLINES OF TABLE 2.

The existing standard dimensions of gaged materials are not changed, but the gage names, the conflicting and arbitrary gage numbers, and the commercial "gage plates" for identifying materials are discarded. The same actual dimensions as hitherto indicated by gage numbers are now to be expressed in decimal parts of the inch, but the unnecessary refinements found in many of the commercial gage equivalent tables are to be dropped.

All material that has heretofore been known by gage number, as No. 20 B. & S. sheet copper, will be known by decimal thickness only, as .032 sheet copper.

Throughout the business of the company, and on all drawings, drawing lists, specifications, bills of material and correspondence, decimal dimensions will be used instead of gage numbers.

In the shop and storerooms all material that has hitherto been "gaged" will be measured with the micrometer or limit gages, and will be specified, ordered, marked and carried in stock by decimal thicknesses instead of by gage numbers.

Drawings, drawing lists, specifications, bills of material, etc., made before April 1, 1904, and specifying gage numbers will not be changed except as found convenient by the engineering department.

The extreme refinements shown by the fifth and sixth decimal places will be dropped, and not more than three significant figures will be used in specifying sizes. By significant figures is meant all figures to the right of ciphers after the decimal point. For example, U. S. Standard No. 2 sheet gage is given as .265625. The Westinghouse decimal for this gage will be .266.

Materials that have heretofore been purchased by gage numbers will be purchased of the same dimensions expressed in decimals.

No sizes of standard materials are to be changed. Materials will be ordered and used in the same sizes as heretofore, the only difference being that they will be designated by decimal dimensions in place of by numbers.

All packages and materials that are ordinarily marked by gage numbers shall hereafter be marked in decimals.

Each storeroom will be furnished with a sheet of instructions relative to the particular materials which it carries.

The marking of all material in stock will be changed from numbers to decimal dimensions. This marking should be done in accordance with the tables for the particular class of material and not in accordance with the exact measurements which the material in stock may show.

In gaging material in the shop, micrometers or limit gages are to be used.

It should be especially noted that, with the exception of twist drills, the above changes do not affect finished articles of any kind such as are kept in stock by manufacturers and known to the trade by gage numbers.

In Table 1 will be found a column giving American screw gage sizes. This has been inserted for convenience in selecting sizes of machine screws and wood screws and it should be especially noted that the gage numbers are retained for these sizes in accordance with the preceding paragraph.

Tables 1 and 2 are for use in those departments whence specifications for material emanate. Columns 1 to 10, Table 2, are for reference in connection with the index in Table 1. In each column the decimals given coincide with a series of "size equivalents", commercially known by "gage name and number." Table 1 ignores all "gage names and numbers"; the dimensions are not numbered in any way, all read from the largest down, and are so arranged with respect to one another that the same (approximate) dimensions are

1	2	3	4	5	6	7	8	9	10
		490		500	500	505			
						492			
						479			
460	.454	.460	.460	.469		466			
						453			
		430		438		439			
						426			
410	425	394	410	406		413	413	413	
							404	404	
						400	397	397	
						397	386	386	
						374	377	377	
365	380	363	365	375	375	361	368	368	
							358	358	
	340	331		344		347	348	348	
							339	339	
						334	332	332	
325			325	313		321	323	323	
							316	316	
	300	307				308	302	302	
							295	295	
289	284	283	289	281		295	290	290	
						282	281	281	
							277	277	
							272	272	
				266		268	266	266	
							261	261	
258	259	263	258	250	250	255	257	257	
							250	250	
		244				242	246	246	
							242	242	240
							238	238	
							234	234	
229	238	225	229	234		229	227	228	220
	220			219			219	221	
						216	212	213	
								209	
							207	206	
204	203	207	204	203		203	204	204	200
							201	201	
							199	199	
							197	196	
							194	194	
		192					191	191	
						189	188	189	
							185	185	
182	180	177	182	188		176	182	182	180
							180	180	
							178	177	
							175		
				172			172	173	
							168	170	
							164	166	
162	165	162	162			163	161	161	165
								159	
				156			157	157	
							155	154	
							153	152	
							151	150	
						150	148	147	
							146		
144	148	148	144	141			143	144	150
							139	141	
						137	134	136	135
129	134	135	129	125	125	124	127	129	125
	120	121					120	120	
								116	
114			114	109		110	115	113	110
							112	111	
							110	110	
							150		
							106	107	
							103	104	
102	109	106	102		100	0973	101	102	100
							099	0995	
							097	0980	
							095	0960	095
								0935	
0907	095	0915	090	0938	090		092	0890	090
			088				088	0860	
							085	0820	085
0808	083	0800	082	0781	080	0842	081	0810	080
			078				079	0785	
							077		
			074				075	0760	075
0720	072	0720	071	0703	070	0710	072	0730	070
							069	0700	
			067				068	0670	
0641	065	0625	063	0625	060		063	0635	065
			059					0595	060
0571	058	0540	055	0563	055	0578	058	0550	055
							056		
0508	049		051	0500	050		060	0520	050
			048						
0453		0475	048	0438	045	0447	045	0465	045
			044					0430	
			042				042	0420	
							041	0410	
0403	042	0410	040		040		040	0400	040
							039	0390	
			038				038	0380	
							037	0370	
0359	035	0348	036	0375	036		036	0360	036
			034	0344			035	0350	
							033	0330	
0320	032	0318	032	0313	032	0318	032	0320	032
							031	0310	
			030				030		
							029	0293	
0285	028	0286	028	0281	028		027	0280	028
			026				026	0260	
0254	025	0258	024	0250	024		024	0250	028
								0240	
0226	022	0230	022	0218			023	0225	022
							022	0210	
0201	020	0204	020	0188	020		020	0200	020
0179	018	0181	018	0172	018		018	0180	018
		0173							
0159	016	0162	016	0156	016		016	0160	016
		0150					015		
0142	014	0140	014	0141	014		014	0145	014
		0135							
0126	013	0128	013	0125	012		013	0135	012
	012		012						
0113	010	0118	011	0109					
0100		0104	010	0102	010				010
		0095		0094					
0089	009	0090	009	0086					
		0085							
0080	008	0080	0085	0078	008				008
		0075							
0071	007	0070		0070					
				0068					
0063				0063	006				006
0056									
0050	005								
0045									
0040	004								004
0035									
0031									002

The following are the names of the gauges to which the dimensions in columns 1 to 10 agree; in some cases the same gauge is known by more than one name.

1: Brown & Sharpe; American Standard Wire. 2: Birmingham; Stubs' Iron Wire. 3: National; Roebling's, Washburn & Moen; American Steel Wire Co. 4: Down to .102 Brown & Sharpe; .090 and down, Trenton or Wolff's Music Wire. 5: United States Standard. 6: Zinc. 7: American Screw. 8: Stubs' Steel Wire. 9: Morse Twist Drill & Steel Wire. 10: Master Mechanics' Decimal.

TABLE 2. GAGE SIZES IN DECIMALS.

on the same horizontal line. This arrangement makes it easy to choose in one column a dimension coinciding closely with a dimension in any other column. In the index of Table 1 the reference numbers indicate in which column of Table 2 to look for diameters or thicknesses of any given material.

Example—In what column of Table 2 must we look for diameters of steel spring wire? Referring to Table 1 opposite "Wire, Spring," and under "Steel" read "3." This means that we must look for diameters of steel spring wire in column 3 of Table 2 only.

Tables 3 and 4 are equivalent tables intended for use in translating from gage numbers to decimal diameters. They are for temporary use only, until the decimal system is well established in the factory and in the several storerooms.

U.S.G.	No.	T.D.G.	S.W.G.	No.	T.D.G.	S.W.G.
.500	7-0			46	.0810	.079
.469	6-0			47	.0785	.077
.438	5-0			48	.0760	.075
.406	4-0			49	.0730	.072
.375	3-0			50	.0700	.069
.344	2-0			51	.0670	.066
.313	0			52	.0635	.063
.281	1	.228	.227	53	.0595	.058
.266	2	.221	.219	54	.0550	.055
.250	3	.213	.212	55	.0520	.050
.234	4	.209	.207	56	.0465	.045
.219	5	.206	.204	57	.0430	.042
.203	6	.204	.201	58	.0420	.041
.188	7	.201	.199	59	.0410	.040
.172	8	.199	.197	60	.0400	.039
.156	9	.196	.194	61	.0390	.038
.141	10	.194	.191	62	.0380	.037
.125	11	.191	.188	63	.0370	.036
.109	12	.189	.185	64	.0360	.035
.0938	13	.185	.182	65	.0350	.033
.0781	14	.182	.180	66	.0330	.032
.0703	15	.180	.178	67	.0320	.031
.0625	16	.177	.175	68	.0310	.030
.0563	17	.173	.172	69	.0293	.029
.0500	18	.170	.168	70	.0280	.027
.0438	19	.166	.164	71	.0260	.026
.0375	20	.161	.161	72	.0250	.024
.0344	21	.159	.157	73	.0240	.023
.0313	22	.157	.155	74	.0225	.022
.0281	23	.154	.153	75	.0210	.020
.0250	24	.152	.151	76	.0200	.018
.0219	25	.150	.148	77	.0180	.016
.0188	26	.147	.146	78	.0160	.015
.0172	27	.144	.143	79	.0145	.014
.0156	28	.141	.139	80	.0135	.013
.0141	29	.136	.134			
.0125	30	.129	.127			
.0109	31	.120	.120			
.0102	32	.116	.115			
.0094	33	.113	.112			
.0086	34	.111	.110			
.0078	35	.110	.108			
.0070	36	.107	.106			
.0066	37	.104	.103			
.0063	38	.102	.101			
	39	.0995	.099			
	40	.0980	.097			
	41	.0960	.095			
	42	.0935	.092			
	43	.0890	.088			
	44	.0860	.085			
	45	.0820	.081			

Letter Sizes			
A	.234	N	.302
B	.238	O	.316
C	.242	P	.323
D	.246	Q	.332
E	.250	R	.339
F	.257	S	.348
G	.261	T	.358
H	.266	U	.368
I	.272	V	.377
J	.277	W	.386
K	.281	X	.397
L	.290	Y	.404
M	.295	Z	.413

U.S.G.= United States Standard Gauge.
T.D.G.= Twist Drill & Steel Wire Gauge.
S.W.G.= Stubs' Steel Wire Gauge.

TABLE 3. DECIMAL EQUIVALENTS OF GAGE NUMBERS.

Letters From Practical Men.

The Metric System in the Machine Shop.

Editor American Machinist:

I have read with interest the articles which have appeared in the AMERICAN MACHINIST from time to time on the metric system; though I cannot claim to have had an extended experience with the system I have had some, and enough, I think, to place me in your classification.

It seems to me that making the change from our English measure to the metric system would be much easier than many would have us think; in other words, the difficulties have been magnified and the advantages minimized. In my copy of "Nystrom's Mechanics" I find the following: "In a lecture on 'Wave Theory of Light' delivered at the Academy of Music, Philadelphia, September 29, 1884, Sir Wm. Thomson said, 'I look upon our English system as a wickedly brain-destroying piece of bondage under which we suffer. I say this seriously. I do not think anyone knows how seriously I speak of it.'" Also "The English *table* is a heap of rubbish *unworthy* the title of system, while the French table exhibits a regular and simple system;" and after twenty years' practical experience with the "wickedly brain-destroying" I think I see relief in sight from my limited experience with the metric.

In making the change I am reminded of my experience when we changed from the old standard (or sun) time to our present standard (or railroad) time. I was an apprentice in the shop at the time, and you would think, to hear some of the "old duffers" talk, that the earth would have to stand still 15 minutes (that being the difference, in the corner of the earth where I lived, between the old and new standards) the morning the change was made; perhaps they expected the earth would stop with a bump and they would be thrown to the ground, but nothing out of the ordinary happened; they all came into the shop by the new time—some late, of course—and by the end of the week you couldn't have found *one* of the objectors if you had gone through the shop with a fine-toothed comb—all that took place was to set the clocks back.

I am of the opinion that if we should find on arriving at the shop to-morrow morning that all our scales, verniers and "mikes" had changed in the night from English to metric we should hardly know the difference, except that it might puzzle some of us who know how big an inch really is, how our inch had shrunk to about three-eighths its present size; but to the fellow who came into the shop the other day with a pulley and wanted "one-half an eighth *reamed* out of the hole" I think it would make little difference what kind of a scale he used.

Of course I know that the change is not so simple as setting the clock back, but it is astonishing to see how quickly one can acquire the habit of *thinking* in another standard.

This is well illustrated in reading a ¼ scale drawing with a common scale or 2-foot rule. We will say that the dimension

No.	B. & S.	B.W.G.	No.	N.W.G.	M.W.G.
7-0			7-0	.490	
6-0			6-0	.460	
5-0			5-0	.430	
4-0	.460	.454	4-0	.394	
3-0	.410	.425	3-0	.363	
2-0	.365	.380	2-0	.331	.0085
0	.325	.340	0	.307	.009
1	.289	.300	1	.283	.010
2	.258	.284	2	.263	.011
3	.229	.259	3	.244	.012
4	.204	.238	4	.225	.013
5	.182	.220	5	.207	.014
6	.162	.203	6	.192	.016
7	.144	.180	7	.177	018
8	.129	.165	8	.162	.020
9	.114	.148	9	.148	.022
10	.102	.134	10	.135	.024
11	.0907	.120	11	.121	.026
12	.0808	.109	12	.106	.028
13	.0720	.095	13	.0915	.030
14	.0641	.083	14	.0800	.032
15	.0571	.072	15	.0720	.034
16	.0508	.065	16	.0625	.036
17	.0453	.058	17	.0540	.038
18	.0403	.049	18	.0475	.040
19	.0359	.042	19	.0410	.042
20	.0320	.035	20	.0348	.044
21	.0285	.032	21	.0318	.046
22	.0254	.028	22	.0286	.048
23	.0226	.025	23	.0268	.051
24	.0201	.022	24	.0230	.055
25	.0179	.020	25	.0204	.059
26	.0159	.018	26	.0181	.063
27	.0142	.016	27	.0173	.067
28	.0126	.014	28	.0162	.071
29	.0113	.013	29	.0150	.074
30	.0100	.012	30	.0140	.078
31	.0089	.010	31	.0135	.082
32	.0080	.009	32	.0128	.086
33	.0071	.008	33	.0118	.090
34	.0063	.007	34	.0104	
35	.0056	.005	35	.0095	
36	.0050	.004	36	.0090	
37	.0045		37	.0085	
38	.0040		38	.0080	
39	.0035		39	.0075	
40	.0031		40	.0070	

B. & S.= Brown & Sharpe or Am. Std. Wire Gauge.
B.W.G.= Birmingham or Stubs' Iron Wire Gauge.
N.W.G.= National or Roebling's or Washburn & Moen's.
M.W.G.= Music Wire Gauge.

TABLE 4. DECIMAL EQUIVALENTS OF GAGE NUMBERS.

actually measures 1⅜ inches; now, instead of reading it 1⅜ and multiplying by 4 in your head or on paper, simply think that your inch has shrunk to one-quarter its actual size; in other words, ¼ *becomes* an inch, then halve and quarter *that* just the same as the inch, one inch becomes four inches, etc., we would read our dimension now as 5½ inches, and *not* as 1⅜ × 4 = 5½. The same is true of ½ and ⅛ scale and I have been surprised how easily you can train yourself to *think* in any one of these scales or to work on drawings drawn in several different scales having to change from one to another rapidly. The same is true of changing from English to metric measure.

One objection to the metric system, it seems to me, lies in the fact that for scale drawings you can't read them without a specially graduated scale, except for half size, as you can divide but once without remainder, as you can with the binary divisions of the inch. Can some of your readers who have had this experience with the system throw light on this point?

Providence, R. I. Z. R. TUCKER.

Another Section Liner.

Editor American Machinist:

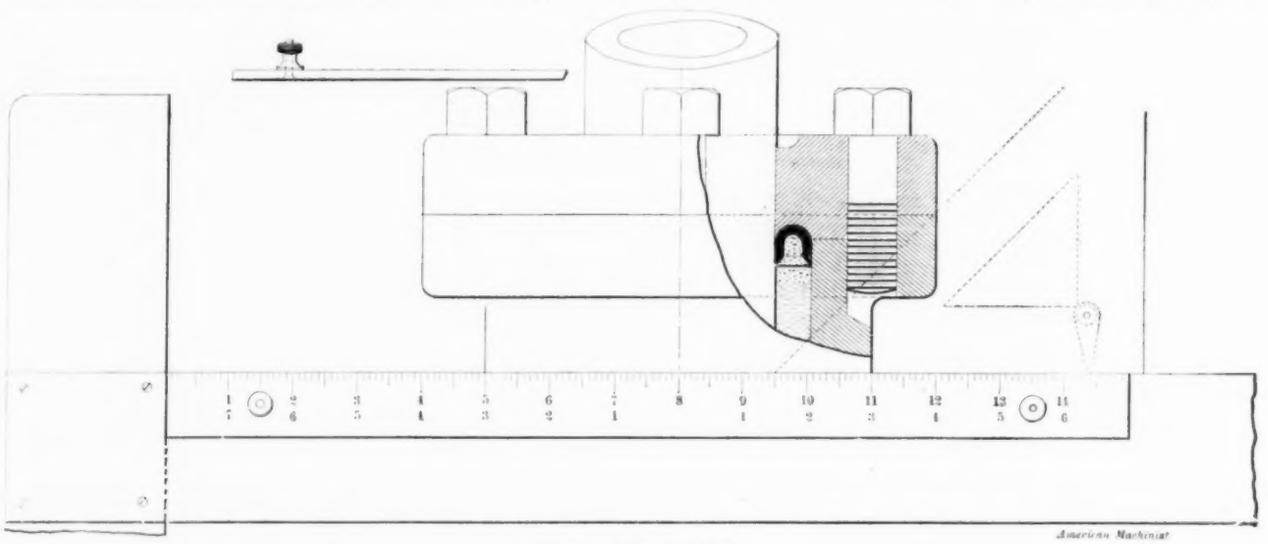
Whenever it can be done, the sense of touch should be used if it will relieve the eyes, for it is a serious matter to overwork optic nerves and muscles. I have found it to fatigue my eyes to use them to gage section lines by, especially if the spaces are to be approximately equal. Of course there are section liners, but those I have tried were not satisfactory for one reason or another.

When my son was home from school during the holidays this subject came up, and he offered to help me out, so one evening, after dinner, he got my drawing equipment in order, then tacked a 15-inch steel scale to the T-square, bolted a piece of tin to a 45-degree triangle with a common wood screw with a leather nut made for the occasion. The tin was pointed and turned down to drop into the division lines on the scale as the triangle is passed along the T-square blade. In less than an hour after beginning on the rig, he was making section lines with it.

After bolting the scale to the square blade as in the illustration and substituting a piece of sheet steel with hardened point for the piece of tin bolted to the triangle, I find the rig very well adapted to my work. If figures are pasted on the scale to read right and left from the center of a drawing, as in the illustration, which shows the top of a hydraulic crane cylinder, the use of the dividers is limited to drawing circles. The figures pasted on are only to guard against mistakes, and to eliminate mental addition and subtraction, which is only fun at 20, but a burden at 60. At that age one needs mechanical appliances for drawing.

The thumb-nut on the triangle makes an excellent handle to pick it up by, or to shift it along the scale and feel the pointer drop into the division marks.

AMOS PRICE.



ANOTHER SECTION LINER.

Marking on Castings—Making Spring Chucks.

Editor American Machinist:

At the close of his article "Marking on Blueprints and on Castings" at page 1834, Vol. 26, Mr. L. O. Danse advocates the use of muriatic and nitric acids in combination with blue-vitriol solution, and I presume the reason is that the acid cuts or eats what little film of oil or grease there may be on the surface of the casting, so that the copper may be deposited.

As blue vitriol is copper sulphate, a saturated solution of blue vitriol is water and sulphuric acid with the copper in solution. The acid being quite dilute does not have strength enough to overcome any amount of oil or grease, but if, instead of muriatic and nitric acids, a quantity of sulphuric acid, about one tablespoonful to four ounces of solution, be added, the acid will not only clean off the oil and grease but will combine with the iron and deposit the copper by virtue of its superior affinity for the former.

I have also used another method of coloring: Heat the piece to be marked to a dark blue, which gives a sharp contrast between the blue surface and the lines made by the scriber, and can be used in the absence of blue vitriol, as some shops do not furnish that article.

At page 191 G. D. shows how he winds

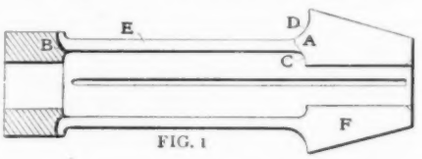


FIG. 1

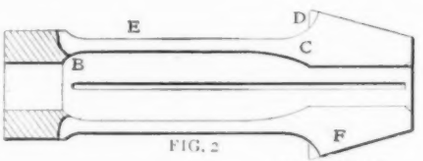


FIG. 2

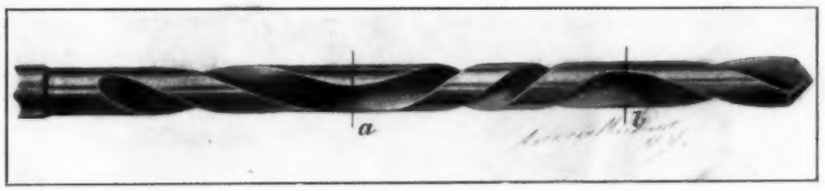
SPRING CHUCKS.

a soft wire around his spring chucks to keep them from springing open while heating and cooling, but I fail to see why the soft wire when hot will hold the jaws of the chuck in place, as the heat will lengthen and also soften the wire, and if there is any "jee whiz" in the chuck tending to spring it apart, it does not seem as though a soft wire would do very much holding.

If G. D. or anyone else is looking for a good way to hold spring chucks from opening while being tempered, he should not saw the slots clear to the end, but leave a little bridge of metal from one jaw to the next one. After the chuck is hardened and drawn, the little bridge can be broken by inserting a wedge or chisel or, better still, it can be sawn away with a thin copper disk charged with emery. On small chucks the amount of metal to be left need not be more than 1-32 inch, while on large ones

the amount can be increased to 1-16 inch or a little more. Chucks held in this way usally remain as made. The sketches show clearly the point to be left.

Most, if not all, chucks fail by breaking either at *A* or *B*, Fig. 1, and, so far as I have been able to observe, the common practise is to make them like Fig. 1, in which the inside corner at *C* has only a small round left by the boring tool or drill and is almost invariably under the outside corner at *D* which in many cases is also quite small and abrupt, while the spring part is quite thin. In the majority



A TWISTED TWIST DRILL.

of chucks the corners at *B* also are left nearly square. This construction leaves a thick body of metal at *F*, as compared with *E* and the unequal rate of heating and subsequent cooling sets up severe strains in the corners.

For several years I have made chucks like Fig. 2 instead of Fig. 1, cutting away the outside as shown by the dotted line, thus leaving a good full curve at *D*, while on the inside the spring *E* is made to a long curve, thus avoiding a sharp corner at *C*. The corners at *B* are also made very full.

G. SCHNEIDER.

A Twisted Twist Drill.

Editor American Machinist:

I inclose a photograph of a drill which was twisted into the peculiar shape that the picture shows while in actual service in this factory. We were drilling the mortise in a hammer for an 800-pound drop hammer, such as is made by this company. The drill was an ordinary taper shank twist drill, 5/8 inch in diameter, made by the T. & B. Tool Company, of Danbury, Conn. It was running at the rate of 170 turns per minute and was drilling soft steel. When the drill had reached a depth of about 6 inches it suddenly twisted as shown in the picture. We consider this a rather remarkable test for a piece of steel, and especially as we noted that the tang or end of the shank was broken off while the fluted and weakest part of the drill did not break but twisted.

FRANK LOMBARD,
Foreman Machine Dept., Billings & Spencer Company.
Hartford, Conn.

[This, we believe, is a most unusual case of twisting. It will be noticed that the yielding of the drill took place mainly, if not entirely, between lines *a* and *b* which we have drawn upon the photograph, and it seems to us likely that the drill has for some reason not been hardened between these points, or that it has in some way become abnormally soft.—Ed.]

Rusting of Couplings.

Editor American Machinist:

Referring to the query of Mr. A. E. Smaill, at page 373, as to why the rust forms between the hubs of couplings and shafts, we believe it is due to a film of machine oil and perspiration from the hands of the workmen. Under certain conditions machine oil will form a rust that will cause a hub to resist all reasonable efforts to move it, when it was originally a free fit. The reason we do not find much of this rust about our engines is that it is not likely to form where the parts are more or less covered with oil all the time, and it of course makes a difference as to the kind of oil used.

J. O. BENEFIEL.

Scribing an Arc of Large Radius.

Editor American Machinist:

Some time ago I had to cut a templet to be used in turning out a gray-iron bowl to a curve of 20 feet radius. The method

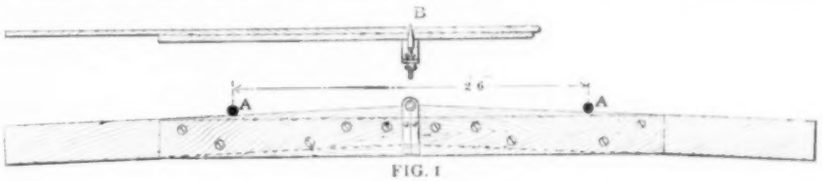


FIG. 1

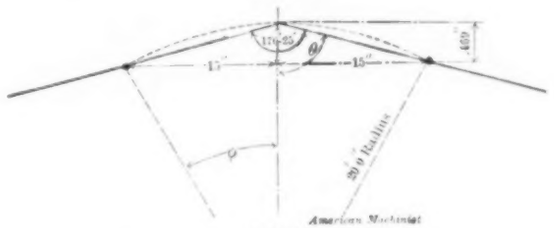


FIG. 2

SCRIBING AN ARC OF LARGE RADIUS.

of scribing the curve may be of interest to some of your readers.

The principle employed was based upon Euclid's Prop. 21, Book 3. Our paternmaker fixed end to end two pieces of wood, each 2 feet 7 inches long, at an angle of 176° 25', Fig. 1. A scriber *B* was held in a bracket at the apex of the angle. Two screws *A A* were fixed 2 feet 6 inches apart to a board and the sheet metal to be scribed was laid and firmly held down between them. Then by moving the scribing arrangement from left to right and from right to left, the edges of the wood being carefully held against the screws, a curve was marked on the metal which was nearly enough a portion of a circle of 20 feet radius. The templet was then cut to the mark and tested again with the scriber point.

Referring to Fig. 2 the calculations are as follows: Assuming the distance between the pins, we have:

$$\text{sin. } \phi = \frac{15}{240} = .0625.$$

Referring to a table of sines, we find that

$$\phi = 3^\circ\ 35'$$

and by again referring to the table, we find that

$$\text{vers. } \phi = .001955,$$
$$240 \times .001955 = .469,$$
$$\text{tan. } \phi = \frac{15}{.469}\ 31.9829,$$

which the table tells us is the tangent of 88° 12½', twice which is the apex angle.

Birmingham, England. R. D. S.

Fixing a Hardened Steel Bushing in an Emery Wheel.

Editor American Machinist:

I noticed recently, at page 338, the rotating emery wheel used as an emery-wheel dresser and I decided to try it. I was more than pleased with the result. I found that wheels which I had trued with a diamond and which I had condemned on account of their glazing gave excellent results when dressed with the emery wheel. I wish here to speak of the way in which I fixed the hardened steel bushing in the wheel for my use. I found that the babbitt center of the wheel would not stand the racket, as I tried it running on the end of a steel rod which I had fitted to it. I rigged up a special forked holder as used on the Huntington dresser and ran the wheel on a fixed pin with a hardened steel bushing in the wheel. I bored the babbitt true in the wheel and then fitted the bushing to it tight. I filed four notches in the corners at each end of the bushing before hardening and after hardening and putting it into its place in the wheel I peened the babbitt over into the notches and it held securely. The bushing was made a nice sliding fit in the babbitt.

HARRY ASH.

Draftmen's Scales.

Editor American Machinist:

As the subject of draftsmen's scales has again been opened, I wish to ask the readers of the AMERICAN MACHINIST why it is that by far the greater number of mechanical draftsmen use a scale graduated in feet, or, rather, proportional parts of feet, although their work is usually measured by inches. Why not use a scale graduated in inches and proportional inches?

The draftsmen's scales usually carried in stock by supply houses, excepting engineers' scales, are divided as follows: 3-32, ⅛, 3-16, ¼, ⅜, ½, ¾, 1, 1½, 3 inches to the foot. Considering a scale of 12 inches to the foot to be full size, these scales will be, respectively, 1-128, 1-96, 1-64, 1-48, 1-32, 1-24, 1-16, 1-12, ⅛, ¼ of full size. Of all these scales, the last two are about the only ones a draftsman engaged on medium size machinery would use. By far the greater percentage of machine details are drawn on the scale of either full or half size. This, of course, does not apply to details of an engine that would not go inside a church, but to the average medium and small size machinery.

A scale of half size, in proportional feet, calls for a rule graduated 6 inches to the foot. Such a scale is not listed by any drawing supply house. Therefore the only way to produce a half-size drawing, with available facilities (considering only proportional feet), is to use a rule graduated in inches and fractions thereof, and divide every dimension by two, or use the scale of ½ inch to the foot, and use that full divided ½ inch as a proportional inch.

The first method is very confusing, and one is very liable to make frequent errors. For instance, if, on a half-size drawing, one wishes to lay off 3 9-16 inches, it would be necessary to measure off one-half of this, or 1 25-32. It can easily be understood how errors are likely to creep into one's work. By the second method—that of using the ½-inch-to-1-foot scale—it will be found that the ½ inch, which is fully divided, is divided into twelve parts, whereas the draftsman usually works with an inch divided into sixteen parts.

To overcome these difficulties, I have for years used the scale shown in Fig. 1. As will be seen, it is a scale of proportional inches, divided in full, half, quarter and eighth size. By reading directly from the scale, a drawing, made to any of the sizes mentioned, can be obtained. No mental calculations whatever are necessary in its use.

Some time ago one of your writers raised certain objections to having two scales upon one edge of a rule. He argued that, by the divisions crossing one another, much confusion ensued. My experience, however, does not bear out his assertion; and I might go still further, and claim that the custom of placing two scales upon one edge is of decided advantage, at least in my case, and for this reason: Suppose, for instance, I am making a full-size drawing and wish to lay off a circle of 3 17-32 inches diameter. It is done by simply laying off a radius of 3 17-32 inches upon the half-size scale. This is done rapidly, and does away with all mental gymnastics in finding the radius as well as to the liability of error.

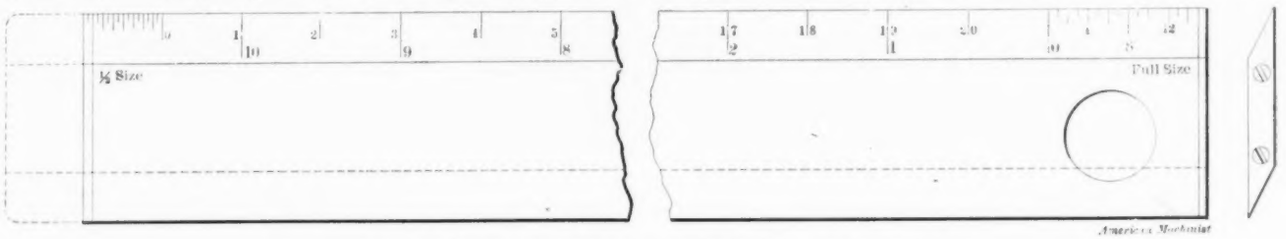


FIG. 1. DRAFTSMAN'S SCALE DIVIDED INTO PROPORTIONAL PARTS OF INCHES.

In using this scale, when in a hurry especially, I found it annoying to have to twist it end for end to get the proper scale, and overcame this very simply, in the following manner: On the full-size end of the scale I pasted a disk of bright-red paper, about ⅝ inch in diameter. I find that the eye will unconsciously take notice of this bright spot of color, and, knowing as I do that it is on the full-size end, I have not a bit of trouble any longer in picking up the scale and placing it down properly. I have not treated the lower side of the scale in this way, to avoid confusion, and besides, I use the one-fourth and one-eighth sizes very seldom, compared with the other two. My scale was originally longer than 12 inches, as the dotted lines show, but I removed the surplus length and added brass end plates, to prevent wear and possible injury. I did this for the reasons that Mr. Lyne advances at page 318.

I occasionally have use for the scales of proportional feet, and, despite Mr. Lyne's assertions to the contrary, I consider the triangular scale quite convenient, altho without the guard or clip he refers to as being occasionally used, it certainly would be the means of provoking much bad language. However, when one considers that it contains eleven complete scales, much might be forgiven. I have used a metal triangular scale for a long time, and am quite suited with it. I must say, however, that the clip is quite indispensable. Any draftsman owning these two scales is, in my opinion, well fixed for scales. The Keuffel & Esser Company, of New York city, make the scales of proportional inches. I would be pleased to hear what some of my fellow-draftsmen have to say concerning them.

Fig. 2 represents two folding rules which I find very convenient to use. I have an objection to them, however, and all who read these lines will know better than to buy the kind of rules I did. To explain: *A* represents a folding rule, graduated, commencing from 1, on the *inside* of the first section. When this rule is opened to take a measurement, it lies as shown flat upon the surface to be measured, with the graduations, *commencing with 1, facing the user*. *B* represents a rule, graduated, commencing with 1, on the *outside* of the first section; and when this rule is opened and laid flat, to take a measurement as in the case of *A*, the graduations facing the user will read backward, beginning at the end of the rule.

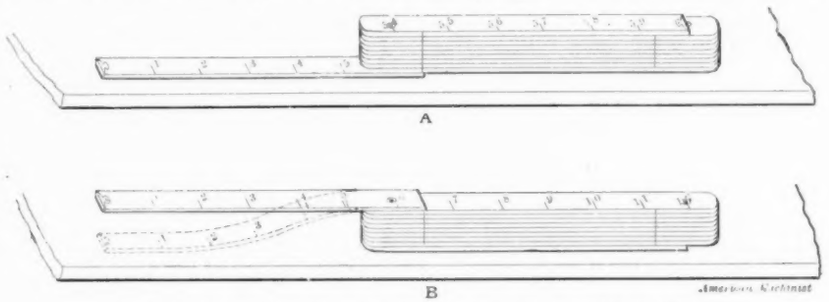


FIG. 2. FOLDING RULES PROPERLY AND IMPROPERLY GRADUATED.

If the rule be turned so that the graduations, beginning at 1, face the user, then the rule occupies the position shown at *B*. With the rule in this position it is impossible to measure, say, 3 inches without opening it out a few more sections, and bending it, as shown. I did not notice this when I purchased my rules, but will know better next time. Any draftsman who proposes to buy one of these rules will save much future hard feeling by looking into this first. These rules are now being made, I understand, like the one at *A*. Anyway, I have two rules for sale, cheap.

I find these folding rules decidedly convenient. One may reach up into shafting to determine diameters of pulleys, etc., or spring them around curves. They are just between the yardstick and the tape, possessing the advantages of both to a great extent. GEORGE WACKER.

Experience with High-Speed Steel.

Editor American Machinist:

At page 228 Mr. D. E. Norris gave the readers of the AMERICAN MACHINIST his experience with high-speed steel and was frank enough to say that it did not come up to his requirements, but what his requirements are Mr. Norris does not state.

About eighteen months ago I had a good chance to try high-speed steel in place of self-hardening steel for planing gray iron of fair quality. The tool point was treated according to directions, brought up to a dripping heat and left to cool in the air and when cool set to work; but it would not stand a short cut of one stroke; the piece was then turned end for end and heated and cooled in an air blast, with no better results. Another piece was cut off the bar, about one-half an inch melted off the end and then cooled in the air blast, with no better results; the other end of the second piece was then heated to a good lemon color and cooled in the air, but was no better than the others. A new piece was then cut off of a new bar and treated in the various ways, but none of them showed the least disposition to stand up to the work. A complaint was then sent to the steel man who replied that if we would send him a piece of the bar he would harden it for us. A piece was cut off and sent on to be hardened and in about a week came back with the point melted off and with instructions to grind and use; the point was ground to the proper shape and an attempt made to use the tool, but with no success; it was no better or harder than I had been able to get it, and the three bars went back. Since that time I have used some high-speed steel that gave good results, and also have had some of the same brand that was, judging by results, no good, and I for one was not at all surprised at what Mr. Norris had to say.

Mr. Waterman says, "And were it not for the high-speed steels the improvement of up-to-date machine tools would not be a necessity," and in reply I may say that work of any kind has always demanded tools built on the anvil principle. Grandfather built light, flimsy tools with small and narrow pulleys, small and short bearings with only iron enough to produce a good vibration and chatter, and for that kind of machine tools grandfather was at fault, not the work, as work has always demanded tools beyond the chatter point. While the use of high-speed steels calls for higher machine speed, I have yet to hear of a clear demonstration where the tools had to have an ounce more iron to make them stiffer and stronger to stand the increased speed, which seems to be the main contention.

I am at a loss to understand and reconcile the comments of Mr. McKenna and the editor, where Mr. McKenna says they are putting four or five times the strain on the tool that they formerly did with the carbon or old-fashioned self-hardening steel," while the editor says "And so he must have put the heavier strain on the carbon tools."

I am unable to understand how anyone can put on four or five times the strain when using high-speed steel as against the carbon tools unless the belts were very loose when using the carbon steel; as very few belts when working at their maximum can stand an extra load of four or five times and a comparison made with carbon steel and a loose belt against a high-speed steel with a tight belt is manifestly unfair. While it is all right and proper to make comparisons and draw conclusions, it should be done without fear or favor and free from bias. GEO. D. TAYLOR.

Grand Rapids, Mich.

Binding the "American Machinist."

Editor American Machinist:

I have read with interest several articles in your columns on binding papers and magazines. I think the scheme at page 195 by your correspondent "S." is the cheapest and easiest I have seen. The objection is that with a half-yearly volume so bound it would be difficult to read the inner columns because it would not open out flat. I will describe what is to me a very satisfactory way; while it is a little more work it does not require extraordinary ingenuity.

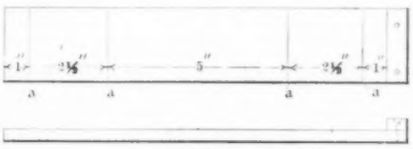


FIG. 1

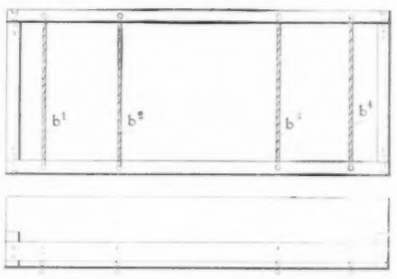


FIG. 2

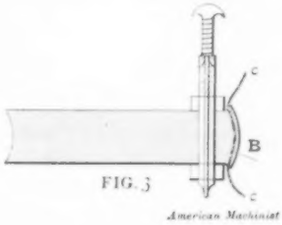


FIG. 3

American Machinist

BINDING THE AMERICAN MACHINIST.

After removing the advertising matter lay each paper on the board, Fig. 1, which is the same length as the paper, and with a small U-shaped gouge cut a notch about 3-32 inch deep at each one of the marks *a a a a*. (The more accurately this notching is done the better the job.) Then make a rough frame as shown in Fig. 2, with four pieces of soft, coarse twine b^1 b^2 b^3 b^4 stretched across it in positions corresponding to the notches already cut in the papers. Lay one paper at a time in the frame so that the notches drop over the twines. Open the paper at the center of each fold, and with a blunt needle threaded with any strong thread (I used ordinary wrapping twine) fasten it to b^1, pass the needle through the hole made by the notch and along the inside of the fold to b^2 and down this to and up b^3, then run the needle out through the notch at b^4. Draw the thread tight to pull the twines all tight in the notches, do likewise with the next successive fold, and so on till all are in. After squeezing them down as close as possible, take the book out of the frame and clamp between two pieces of board as in Fig. 3, which is an end view. Cover the back at *B* with a good coat of hot glue and stick on a strip of cloth. When this is set remove the clamps, put on board backs and glue in the ends of the twine *c* and c^1. Cover with some strong, dark colored cloth, cut out the title from a title page and paste on the front lid, and you have a strong, neat job; not a very big job, either. When binding in this way the index should be inserted the same as the other sheets. C. H.

Draftsmen's Spelling of Superseded.

Editor American Machinist:

There is not a word in the English language which is abused as much as this word, especially by draftsmen and engineers, who have occasion to use it now and then. When it is used on drawings it usually has a very conspicuous place.

The most popular way of writing it is "superceded," which seems almost to be an adopted "standard." Next comes "superceeded," which some prefer, probably because it reminds them of succeeded. Once in a great while some original chap will come along and spell it "superseeded," "superseaded" or "superceaded"; but the right way of spelling it, *superseded*, is used so seldom that it is hardly worth while mentioning. Any draftsman can prove this by looking through a drawer of superseded drawings.

A. D. RAFTSMAN.

The London *Times* notes as an unusual occurrence the recent tapping, at Snaresbrook, of a 24-inch water main and the attachment of a 12-inch branch to it without shutting off the water pressure. This is an every-day occurrence in this country. An American machine was employed in the case referred to.

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The Auto Truck Test in New York.

At page 335 we gave an account of the proposed service test of motor wagons to be made under the auspices of the Automobile Club of America by its Committee on Testing, of which the chairman is John A. Hill. This took place between the 4th and 9th of April, inclusive, and the result is most impressive as showing the advances that have been made in practical, serviceable automobile design and construction. Eighteen trucks entered, seventeen started and sixteen finished. These trucks included electrics, gasolines, one steamer and one combined gasoline and electric—that is to say, a truck in which a gasoline engine drives a generator supplying current through a storage battery to motors. Only one vehicle failed during the test, and that, strangely enough, was the steamer, tho there was in this case a special reason for this failure, the boiler leaking badly and for reasons not inherent in automobile boiler construction. It is significant, however, that of the entire number of vehicles only one steamer was entered. The service performed by the trucks was the most practicable that could be imagined. They were placed in the service of express companies, and with a driver, an expressman and an observer aboard of each one, performed the regular service of the companies in and around New York city, each truck taking, alternately, a regular run which is ordinarily covered by horse-drawn vehicles. Some of the vehicles covered fifty or more miles in the day, and made a hundred or more deliveries of express packages. They carried loads varying from 500 to 10,000 pounds, and the performance on the whole was entirely satisfactory to the express companies and to those interested in the trucks. The complete detailed account of what was accomplished and the manner in which it was accomplished has not yet been made up from the records of the observers, but will be given out later. In the meantime, however, the facts given have been made known, and it is interesting to recall that almost exactly eight years ago the first trial of automobiles ever made in this country took place. Twenty-six automobiles undertook to run from the City Hall to the Ardsley Club, twenty-six miles away. Four vehicles arrived, all the others failing entirely to make the run, while the one which made the fastest time arrived five and a half hours after the start, or at the rate of less than five miles an hour, and they carried no loads to speak of, nor were they required to make any stops. Comparing this record with the one just made by the motor trucks gives a vivid idea of the very great and creditable advance that has been made in the art of motor car construction, and makes it seem more than ever probable that the day of the horse-drawn vehicle in city streets is happily nearly over.

Alleged Economic Inferiority of American Locomotives.

The Engineer, of London, is "sot" in its opinion that the American locomotive is little if any good. It not only believes that it is not as well built as the British locomotive, but that it is built so poorly that it is an uneconomical machine; and, as showing what one will do in the way of jumping at conclusions which seem to support his side of an argument, we note with interest the comments of our contemporary upon some things pertaining to the operation of the Pennsylvania Railroad. It seems that at the close of the recent great rush of its business the Pennsylvania road found itself with about 20 per cent. of its locomotives in need of repairs, and that owing to the number of disabled locomotives the road has been obliged to send some of them to outside shops for repairs. This is taken by our contemporary as proving conclusively that it does not pay to build engines to be worn out so soon, and that much better material and workmanship should be put into them, as it claims is done in British locomotives. Now, of course, the fact is that there is a great hiatus in this chain of logic. The fact is that the facilities of the Pennsylvania Railroad for repairing its locomotives might conceivably have been such that during any given rush of business it would find itself with 90 per cent. of its locomotives needing repairs. On the other hand, its facilities might conceivably be such that there would never be more than 1 per cent. of its locomotives needing repairs. In this latter case would our contemporary grant the superiority of the American locomotive on that showing?

The fact is that this is a matter of the relation between three factors; that is, first, the rapidity with which engines deteriorate; second, the number of engines in service, and third, the facilities for repairing those engines, and any reasoning or conclusions based upon only two of these factors, leaving out the third, must necessarily be incomplete and inconclusive, and therefore the figures quoted by our amiable contemporary do not in the least show what it claims they show.

We are informed by a member of the committee having charge of the land purchase for the union engineering building that very thorough examinations have been made regarding the titles to the land acquired and that there are no restrictions whatever upon it. In the case of a strip 30 feet wide which it was proposed to include in the purchase it was found that a restriction to use for residential purposes went with the title and the committee thereupon dropped negotiations for that particular strip. The rest of the land, however, is entirely clear.

We are continually having trouble with people who, in replying to advertisements under the head of Help Wanted, enclose

with their applications original letters of reference that are of value to them, and which they often have difficulty in recovering. If our friends will read the heading at the top of this department they will perceive that we advise against the enclosing to unknown correspondents of original letters of value. It ought never to be done. Copies of such letters will usually answer every purpose, and it is to be hoped that persons applying for positions will heed this advice and retain in their own possession letters that are of value.

The Turbine Steamers for the Cunard Line.

The report of the turbine commission on the new steamships for the Cunard line contains many details of interest. The two ships soon to be built are to be 760 feet long, the breadth will be 85 to 88 feet and the draft 33 to 34 feet. The horse-power of the engines will be 65,000, and the coal consumption will be more than 1,000 tons per day. It is well known that these ships are to be driven by steam turbines instead of the usual reciprocating engines, and the report of the commission discusses the advantages and the disadvantages of the turbine for the purposes of the merchant marine. A point which will be more or less of a surprise to many is that little saving of weight or area is expected from the use of the turbines. The estimated weight for the enormous power in the ships is only 300 tons less than that of reciprocating engines, and even this the builders are recommended not to take advantage of in the way of appropriating more space for cargo, but to hold it for unforeseen contingencies. There will be a considerable reduction of the working force of the engine-room and an elimination of the lubricating oil in the steam. An important disadvantage pointed out is that low speeds will not be economical, thus reversing all previous experience. Experiments seem to render it quite certain that at high speeds, say a uniform expected speed of 24½ knots, the economy will be better than that of the present type of engine. It is recommended that four shafts be used, with, of course, separate turbines and screws for each. With three shafts working at their maximum the power transmitted through each would be about 25,000 horse-power, while with four shafts this would not much exceed 18,000 horse-power, which would not be going beyond experience. The speed of revolution will be comparatively slow, but the turbines will be required to be of large diameter to develop the power required, so that the peripheral speeds will be high. This great diameter of the turbines has to do with determining the location of the shafts. There will be one go-ahead turbine on each shaft, and they will be almost equidistant from each other. The high-pressure turbines will be on the two outside shafts with their propellers at a considerable distance from the stern of the ship, so that there will be the minimum disturbance to the flow of water to the two inside propellers, which will be placed right aft in the usual positions. There will be two turbines on each of the inside shafts; that is, there will be two low-pressure turbines for driving ahead and the other two will be for astern motion. The go-ahead system thus comprises two steam units, each with one high-pressure and one low-pressure turbine; should, however, either turbine or propeller give out, it will still be possible to use the other three without loss of economy and with little loss of speed. The arrangement is expected to show high maneuvering qualities, and is being studied with great interest by the naval authorities. The construction, on the whole, is so largely experimental and so novel in many of its details, that the vessels will be paid for not at a fixed sum for each, but on a basis of material and time. One of the ships, it is understood, will be constructed by Messrs. John Brown & Co. (Limited), Clydebank, and the other by Messrs. Swan, Hunter & Wigham Richardson (Limited), Newcastle-on-Tyne.

A School for Locomotive Driver Apprentices.

Brainard H. Warner, Jr., United States consul at Leipzig, sends an account of a school for locomotive driver apprentices lately established at Dresden. The initiative was taken by the Locomotive Drivers' Association of Saxony, which succeeded in interesting the members of the Dresden city council in the scheme, as well as the directors of the technical school and the administration of the royal state railroads. The purpose of the new school, which is managed in connection with the Dresden Technical School, is to better equip men who are to become locomotive drivers. The school is for apprentices between twenty-five or thirty years of age who are employed in the Dresden car shops. Among the subjects taught are German, arithmetic, graphics, and the mechanism of locomotives. For the present the course has been fixed for one year. The lectures and classroom work will be held on three evenings during the week and on Sunday mornings.

Summer School of Rochester Mechanics' Institute.

The Mechanics' Institute, of 55 Plymouth avenue, Rochester, N. Y., will open its summer school July 5. The courses which are of interest to our readers comprise mechanical and teachers' drawing, architectural drawing, forging and bench work in wood.

The Metric System Before Congress.

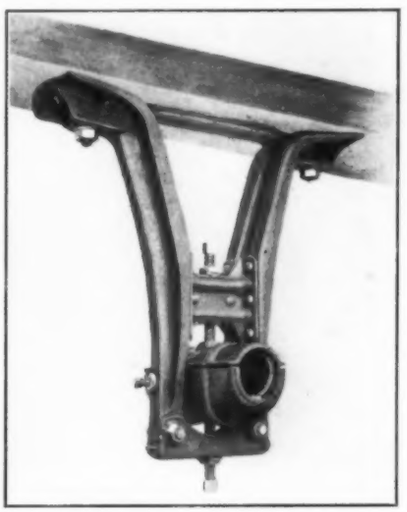
At the hearing of the House Committee on Coinage, Weights and Measures, held April 7, Messrs. Oberlin Smith and Wilfred Lewis made protests against the passage of the pending bill.

The National Machine Tool Builders' Association will meet at the Grand Hotel, Cincinnati, April 26 and 27.

Some New Things.

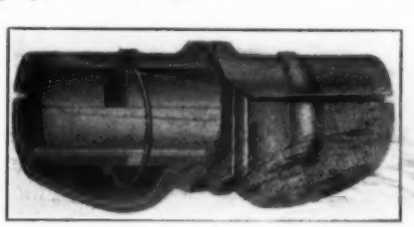
PRESSED STEEL SHAFTING HANGER.

The present tendency to substitute drawn or pressed steel for gray-iron castings has its latest example in a pressed steel shafting hanger which we illustrate herewith. As will be seen, this hanger consists of two principal parts which are so formed as to embody ribs giving rigidity and strength, these being joined together at the top and again just above and below the point at which the box is held, as



A PRESSED STEEL SHAFTING HANGER.

shown. It will be noticed, also, that the lower cross member is fastened in place by two bolts, either one of which may be removed when this piece hinges upon the remaining bolt, allowing the box to be readily removed. Hangers constructed in this way weigh, without the boxes, only about two-fifths as much as cast hangers intended for the same service, and including the boxes, only about half as much. The box used in this particular hanger is also shown. It is a gray-iron casting divided longitudinally on a horizontal plane as shown, and provided with spherical seats for the adjusting screws by means of which it adapts itself to the position of the shafting. Below the box proper is an oil pan between which and



BOX USED IN STEEL HANGER.

the box is a spherical bearing, while the oil pan itself also rests on a spherical bearing, so that while the oil pan is held in a fixed position the box may adjust itself within the pan without restriction within reasonable limits. This oil pan is sufficiently large to hold a liberal supply

of oil, which is continually carried to the bearings by means of the ring oiler device as shown. This hanger may be turned up the other way to form a floor stand, it being necessary in that case only to turn the box and oil pan upside down within the hanger. This improved hanger is made by the Standard Pressed Steel Company, Twentieth and Clearfield streets, Philadelphia, Pa.

BALL BEARING.

The ball bearing shown in the accompanying engravings would seem to be simplicity itself, consisting as it does—in addition to the series of balls—of but three members; *i. e.*, the inner race, the outer race and the closure screw. It is handled as a complete unit, as it requires no special retainers to keep the parts together and the balls from being lost. Its application to a machine also is exceedingly simple, as only a cylindrical shaft fit and cylindrical bore are required. Adjustable cones are entirely dispensed with, it having been found that, under loads experimentally determined as proper, the wear is so slight as to be negligible. In illustration of this fact, it may be cited that in Berlin, where these bearings were developed, trial on the armature of a heavy street car motor developed no measurable wear of balls or races in two years' run with only one annual cleaning and oiling; as a result there are now in use in Berlin alone over 100 such street car equipments.

FIG. 1. BALL BEARING.

A few applications of this bearing to various types of shafts are shown in the line engravings, and it will be noticed that where the outer race passes across the inner end of the screw, the bearing is so positioned that the pressure due to the load comes on the side of the ring directly opposite the screw.

Fig. 2 shows an application to a pillow block for 6 tons load; the very short overall length of the bearing—in this case less than one shaft diameter—is characteristic. In order to keep oil in and dust out, the bore of the box ends is but 1-64 inch larger than the shaft; what little oil is carried past the inner stripper is turned back by the outer stripper into the cored pocket, and from this drained back to the main reservoir. This type of oil retainer can of course be used only with bearings that have no appreciable wear, since it is dependent upon the maintenance of the small clearance between the shaft and the box end.

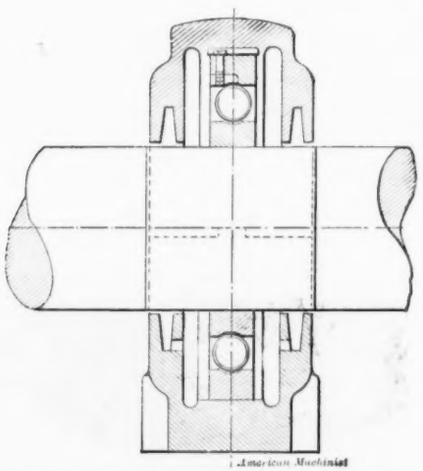


FIG. 2. PILLOW BLOCK FOR 6-TON LOAD.

As showing the possibilities for compact construction lengthwise, Fig. 3, a steam automobile crank shaft, is shown; in this not only the main journals, but also the crank pins and the valve eccentrics are equipped with ball bearings.

Fig. 4 gives the two journals of a steam turbine running at 3,000 turns per minute. The standard practice of taking the entire load on a single ball bearing is adhered to, as this avoids all difficulties of load distribution among several bearings and the necessity of extraordinary stiffness in the shaft and framing to insure such distribution being maintained under varying loads. As with a steam turbine it is desirable to take up all end thrust, two ball-bearing units have been introduced at one end of the larger journal. An examination will show that these units have no bearing on their outer circumference, but are confined endwise between shoulders on the shaft and in the box; these thrust units are in every way similar to the others, and have been found to make excellent step bearings under high speeds. This same figure also shows the means employed for securing the inner race of the ball bearing to the shaft when it is inexpedient to make the latter a light driving fit, or when, as in line shafting, the size varies slightly: a pair of split bushes externally and internally coned are forced over one another with a very decided clamping effect by means of the short spanner nut. This arrangement has the merit of secur-

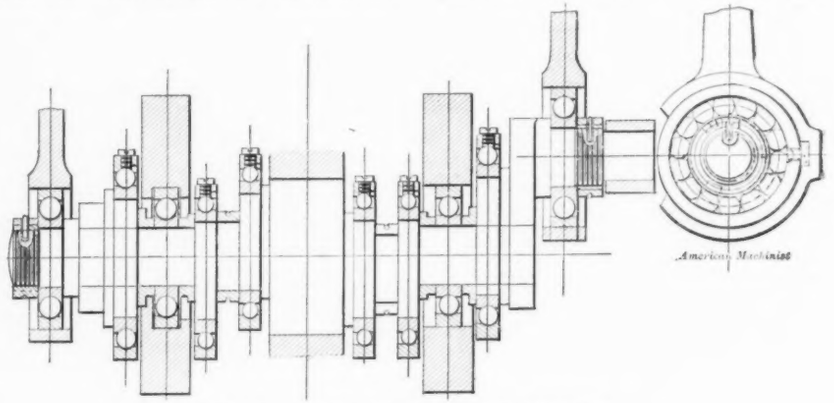


FIG. 3. STEAM AUTOMOBILE CRANKSHAFT.

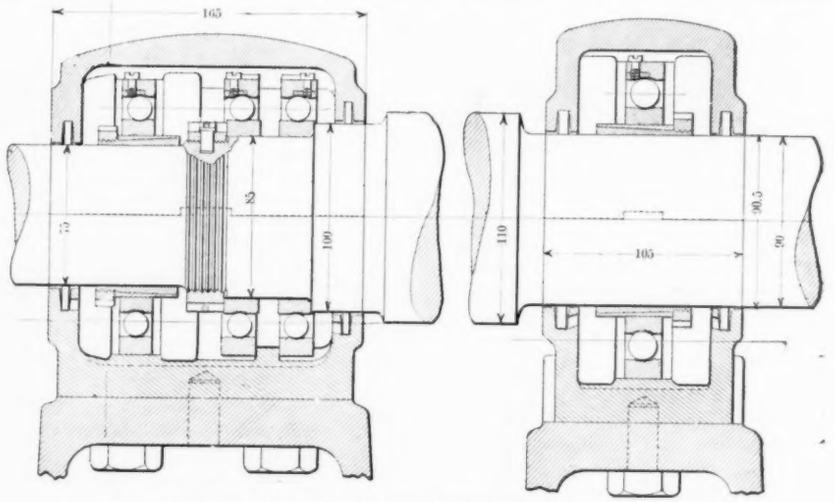


FIG. 4. STEAM TURBINE BEARING (DIMENSIONS IN MILLIMETERS.)

ing actual true contact all around, and hence is much better than set screws or similar fastening device, as it does not tend to throw the parts out of true or mar the shaft.

An example of the use of ball bearings for rather heavy work is shown in Fig. 5 showing the waist and step patterns of a

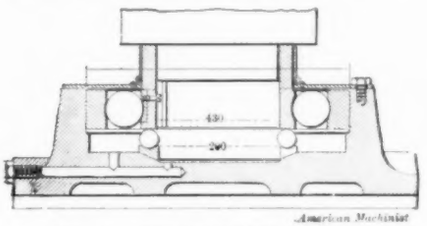


FIG. 5. WHARF CRANE BEARING.

wharf crane; the bearings are subject to loads of 7½ and 17 tons. Here again it will be seen that the lengthwise space required is exceedingly small as compared with the usual journal proportions.

The bearing is made in this country by the Hess-Bright Manufacturing Company, Pennsylvania Building, Philadelphia, Pa.

UNIVERSAL CUTTER AND TOOL GRINDER.

The half-tones illustrate a machine designed for grinding all kinds of milling cutters, reamers, etc., and for handling various kinds of work where cylindrical, face, and surface grinding operations are required.

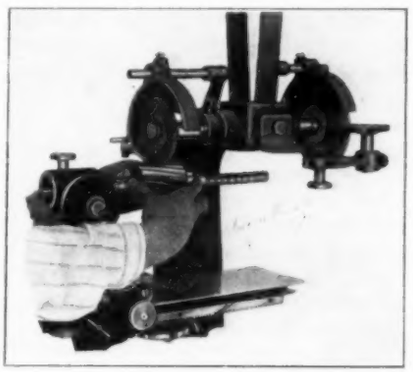


FIG. 2. GRINDING SPIRAL CUTTER.

The column of this grinder, as will be seen by referring to Fig. 1, is cast in one piece and so constructed at the top as to permit work to be passed directly under and in front of the emery wheels, which are mounted on a spindle provided with adjustment to take up wear, and equipped with conveniently arranged and efficient guards. Projecting at the front and left of the column is an arm which is bored to receive the cylindrical post that carries the working parts of the machine. This post has vertical adjustment by means of a screw at its center, the hand-wheel at the left being connected by a shaft and bevel gears. The hand-wheel is graduated in thousandths, and, as it is large in diameter and the screw of fine pitch, the graduations are far enough apart to allow fractions of a division to be estimated very accurately. The bed on which the carriage slides is arranged to swivel on top of the post, and, as the circular portion is graduated in degrees, may be clamped at any angle. The carriage can be traversed in two ways: First, by means of the hand-

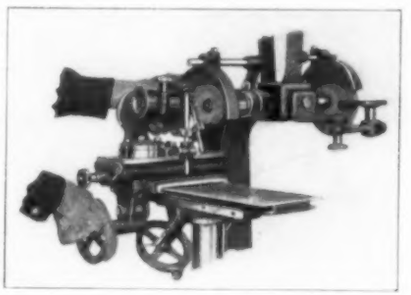


FIG. 3. GRINDING A SIDE MILL.

wheel in the front, the gearing operated by this wheel engaging with a rack on the bed; and, second, by moving the carriage out to the end of the rack and pulling out the idler gear, when the carriage can be reciprocated by hand, the object of removing the gear being to keep the hand-wheel from turning, as its inertia retards the movement of the carriage when it is reversed. The movement by means of the hand-wheel is, of course expected to be much slower. The head is universally adjustable, both horizontal and vertical swivels being graduated in degrees. The tooth-rest holder is clamped to a bushing outside of the spindle bearing, and can be moved

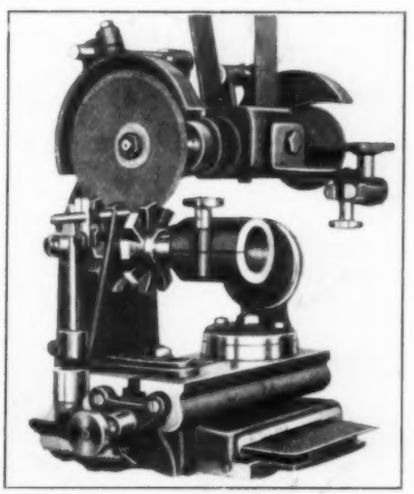


FIG. 4. SHARPENING A FORM CUTTER.

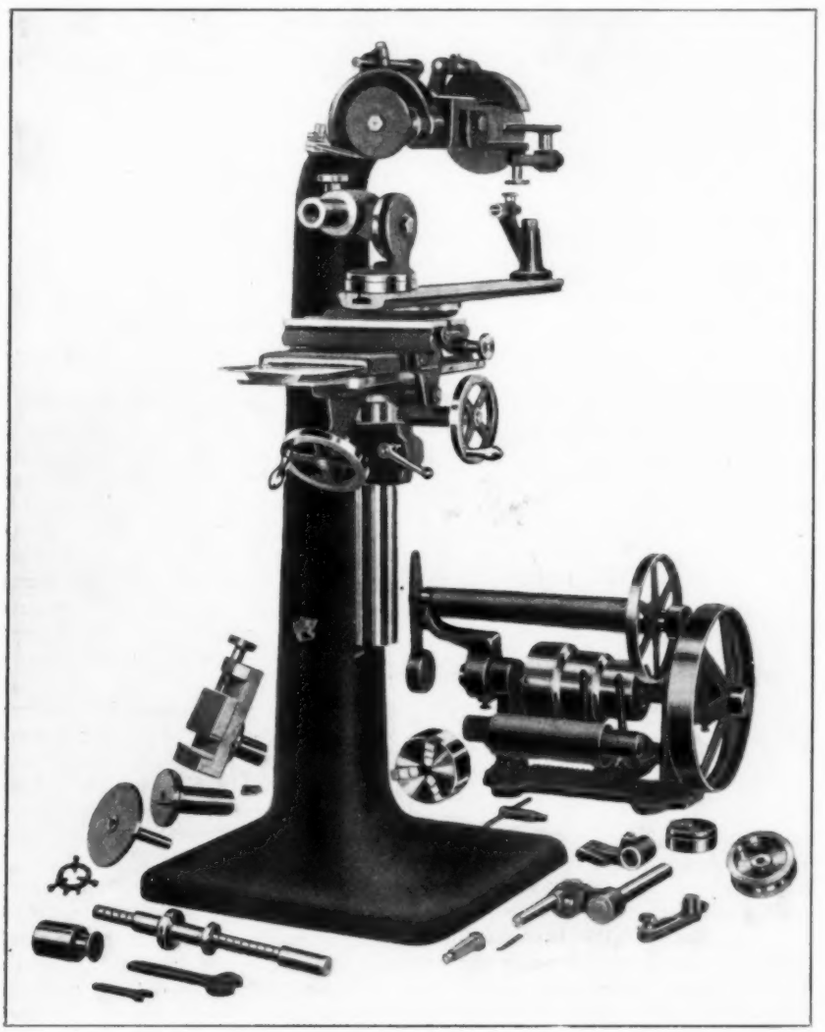


FIG. 1. UNIVERSAL CUTTER AND TOOL GRINDER.

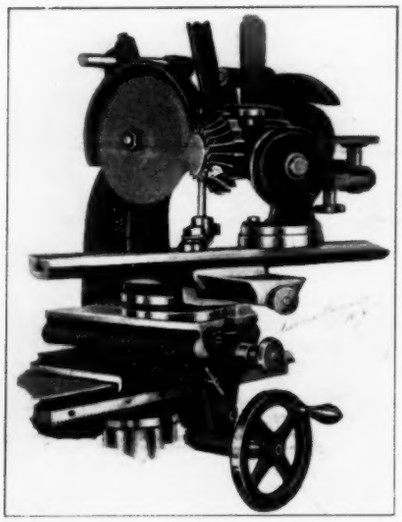


FIG. 5. GRINDING CONCAVE CUTTER.

so as to bring the rest to any point on the periphery of the emery wheel. A tooth-rest holder is also provided that can be clamped to the platen of the machine to travel with the cutter as it is being ground.

The countershaft also has some interesting features, one being the provision for two speeds with only one size of pulley

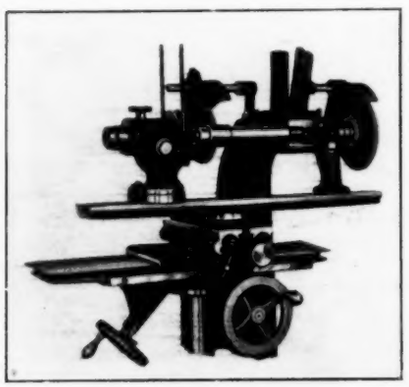


FIG. 6. GRINDING A BUSHING.

on the line shaft. These speeds are obtained through two pulleys of different diameters, which pulleys are fast on the countershaft with an intermediate size loose one between them, the loose pulley as well as the tightener shaft being made

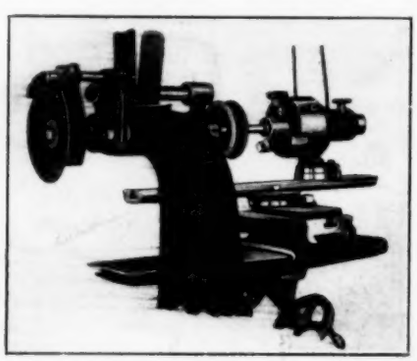


FIG. 7. INTERNAL GRINDING.

self-oiling. The drum for rotating work for cylindrical grinding is thrown into action by a pull on a cord and stopped by another pull. The drum shaft is provided at its ends with eccentric bushings, and a weighted lever, as shown, is connected in such a way that, when this lever is drawn past the center by the operating cord, the drum is lifted until a pulley fastened on its inner end comes into contact with a rawhide collar on the countershaft which then drives the drum until the cord is again pulled to drop drum and pulley.

In Figs. 2 to 9, inclusive, are shown a few of the many operations for which the grinder is adapted. Fig. 2 illustrates the method of grinding a common spiral milling cutter, the carriage in this case being locked fast and the cutter slid on a bar

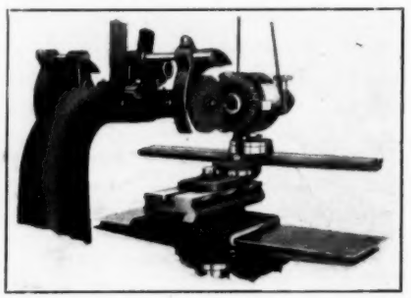


FIG. 8. A FACE GRINDING JOB.

directly under the emery wheel. This grinding can be done in front of the wheel as well as under it, and the teeth may be ground with straight clearance with a cup wheel, if desired. Fig. 3 shows a cutter being ground on the side. The bed in this case is swiveled slightly more than 90 degrees so that the carriage travels practically at right angles to the spindle.

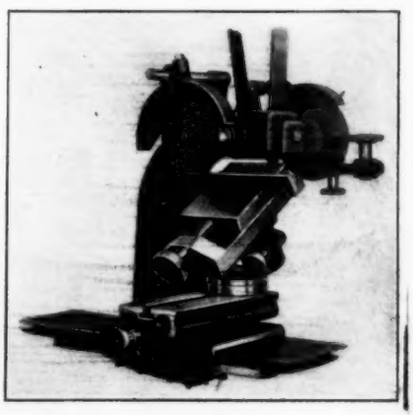


FIG. 9. SURFACE GRINDING.

and the head is tipped forward to give the proper clearance. Fig. 4 represents the grinding of a form cutter which is mounted on a sleeve that is free to turn on an arbor carried by the head; and Fig. 5 shows the arrangement for grinding concave or convex cutters, the swiveling base being set to give the required radius and the head then swung back and forth between stops on the base.

Fig. 6 illustrates a cylindrical grinding operation, the work being a bush or an arbor carried between centers. An internal grinding operation is shown in Fig. 7. Fig. 8 depicts a face-grinding job; the work is held in a chuck, and the bore may be finished at the same setting by means of the internal fixture. In Fig. 9 is brought out the method of grinding a bevel edge on a piece. The vise may be set flat, or, by means of the universal holder, at any angle whatever, so that parallel, bevel, or taper work may be handled readily.

In order that small taper shank end-mills, etc., may be ground conveniently in this machine, the spindle in the universal holder or head shown in the different views is provided at the front end with a No. 10 Brown & Sharpe taper hole to receive such tools, and the rear end is knurled so that the work may be turned readily by the hand.

This grinder is built by Kearney & Trecker, Milwaukee, Wis.

Technical Publications.

The author of "Facts About Peat," of which we gave a notice at page 339, writes us a letter from which we make the following extract:

"At page 339 there is a notice of my little book, 'Facts About Peat,' in which your critic appears to have found it difficult to 'extract' anything 'definite' from what is there very distinctly stated concerning the process for *condensing* as distinguished from *pressing* the peat, and thinks 'the author has something up his sleeve which his book does not directly disclose.'

"Now I have no fault to find with any intelligent criticism or 'notice' of this or any other publication, for the column of 'Book Notices' is understood to be for the free expression of opinion concerning the merits of publications; but as 'the fuel question' is one of universal interest, and to none more so than to the manufacturing class whose interests are catered to in your publication, and as this is the only adverse criticism of which I have known out of the multitude of notices that my publishers have shown me, I venture to write this for your personal information and for your critic if you like to show it to him.

"The book was prepared for the purpose distinctly stated in the opening paragraph and was intended to give, in as concise a form as possible, such facts and data as would commend it to the serious consideration of practical men and invite investigation and inquiry.

"The two *processes* of 'pressing' and 'condensing' were distinctly given, but no attempt was made to describe the machinery by which either was accomplished: the plan of the book did not contemplate this and the limit of space would not admit of it.

"Of the latter process 'condensing' your

critic says, 'we are left in the dark.' Now, if he will take the trouble to turn to page 40, paragraph second, he will find the condensing *process* distinctly stated. It is exceedingly simple and given in so few lines that in his (probably) hasty perusal he may have overlooked it, else he could not have been 'left in the dark.' You will readily understand that it is one thing to state what a process is and quite another thing to describe in detail the mechanism by which that process is made effectual."

We are uncertain whether Mr. Leavitt, in referring to the second paragraph of his page 40, means the second of which the beginning appears on that page or the second of which any portion so appears, and hence, in order to do full justice, we give below both paragraphs:

"*Condensed* peat fuel differs essentially from the *pressed* article already described and commented upon. The process of manufacture is exceedingly simple, rapid, and successful. The plant required for its production is comparatively inexpensive; the expense of manufacture is small, and the fuel produced is superior in many respects to that produced by any other process.

"The crude material is excavated and brought from the bog in any convenient manner. The treatment is such that the original organization of the peat is destroyed; the air, of which a large amount is contained in its cells, is ejected; its plastic and adhesive properties are developed; advantage is taken of some of the peculiar natural qualities of the material, and it is then in condition to be blocked or molded into any form desired, which may be accomplished in a variety of simple ways. It is then exposed in the open air for drying, or artificial means may be used to expedite this. I have made good steam fuel in four or five days' exposure in the open air; but, like wood, it improves with age. These blocks when broken may have the variety in size and shape that we are accustomed to find in coal. The fracture has much the appearance of a mineral fracture. It cannot be dissolved or reduced to its original consistency."

Possibly our readers can extract some definite information regarding condensed peat and its difference from pressed peat from these paragraphs, but we must confess that we are as much in the dark as ever.

The Niles-Bement-Pond Company has recently secured a $95,000 order for tools for the Spencer, Columbia and Manchester shops of the Southern Railway.

Inquiries for Machinery.

(174) We have an inquiry for name and location of manufacturers of a babbitt metal called "Ball Metal."

(175) Another inquirer asks for name and address of concern handling "Scandinavian" belting in this country.

Personal.

Ernest W. Saunders, recently with the American Machinery Company, is now in the New York office of The J. R. Vandyck Company as machinery salesman.

E. A. Muller, who for several years has been superintendent of the Springfield Machine Tool Company, has resigned to take a similar position with the King Machine Tool Company, of Cincinnati, Ohio.

It is announced that Mr. Louis P. Diss, who for many years has been connected with the Remington Works at Ilion, N. Y., and latterly has been superintendent of the Remington Typewriter Works, has retired from that position. On the occasion of his retirement Mr. Diss was presented by the various department foremen with a fine gold watch, suitably engraved.

The editor would like the address of Earnest T. Child.

Obituary.

As we go to press the news reaches us that Frank Kempsmith, of Milwaukee, died April 10. Later we will give some account of his life with a portrait.

Many and probably most of the shop accidents occur not when everything is going along in its orderly and accustomed way, but when interruptions or unusual things occur. J. W. Chapman, a machinist in the employ of the Central of Georgia Railroad, was instantly killed at Macon a few days ago. He was trying to raise one of the engines placed over the pit for repairs, when the air jack failed to work. Chapman went under the engine to investigate, and while manipulating the jack his head was caught and crushed between the ram and a part of the engine.

Business Items.

The extensive improvements contemplated by the Phoenix Cement Company, Nazareth, Pa., have all been laid out by Dodge & Day, modernizing and contracting engineers, Nicetown, Philadelphia, Pa., and it is thought the work will be started in the near future. Most of the buildings will be enlarged, electric transmission used throughout, and the entire plant thoroughly modernized in order to materially increase the output to keep pace with the growing demand for its product. This will necessitate the installation of considerable additional power equipment, as well as a 200-kilowatt generator, tandem compound engine for generator, one 50 and one 75 horse-power motor and a number of smaller motors; charging cars, turntable, coal and ashes conveyor, underfeed stokers, steam locomotive for hauling cars to and from the quarries; electric hoist, electric air compressor, blower and exhauster, air-cooling conveyor, belt conveyors, elevators, automatic weighing machine, extension of track system, etc.

Manufacturers.

Evansville, Ind., expects shortly shops of the Illinois Central.

A stave mill of A. J. Asher, near Pineville, Ky., has been burned.

The Industrial Iron Works at Union City, Pa., have been damaged by fire.

The Union Electric Company, Dubuque, Ia., is to build a power-house.

The large plant of the York (Pa.) Carriage Company has been burned.

The machine shop of Ervin Bauder, Sterling, Ill., is being enlarged.

The Baltimore (Md.) Carriage & Toy Factory has been damaged by fire.

The Philadelphia Screen Manufacturing Company plans for a three-story addition.

The Trinity & Brazos Valley is building a "long house" and shops at Cleburne, Tex.

A canning factory is proposed for Cokato, Minn., by G. P. Olson, Frank Swanson *et al.*

The plant of the Silver Plate Cutlery Company, Shelton, Conn., has been damaged by fire.

The Coombs Milling Company, Coldwater, Mich., proposes to make important improvements.

A paper mill of the Hollingsworth & Vose Company, at East Walpole, Mass., has been burned.

Plans have been prepared for an addition to the Detroit (Mich.) Cabinet Company's factory.

Springer & Lester, founders and machinists, Knoxville, Tenn., are building a small addition.

The Bullard Machine Tool Company, Bridgeport, Conn., has discontinued its New York office.

A building of the American Graphophone Company, at Bridgeport, Conn., is about to be enlarged.

The Calumet Grain & Elevator Company plans to build a 250,000-bushel elevator in South Chicago.

The Riverside (Textile) Manufacturing Company, of Anderson, S. C., intends to double its plant.

The Centredale (R. I.) Worsted Mills are understood to have completed plans for a plant at Olneyville.

A boiler and engine house is to be built for the Fern Rock Woolen Mills, at Fern Rock, Philadelphia, Pa.

The contract has been let for a three-story, 100x100-foot addition for the Lindner Shoe Company, Carlisle, Pa.

A large furniture factory at Greenville, Mich., for Skinner & Steenman, of Grand Rapids, is planned for.

It is reported that the shell button factory of Leo H. Hirsch & Co., Muscatine, Ia., will be enlarged for some purpose.

Plans have been made for a two-story factory addition, 51x145 feet, to the plant of the Toledo (O.) Cooker Company.

The H. F. Sidway Manufacturing Company has moved from Chicago, Ill., to Elliston, a new addition to Elkhart, Ind.

It is reported at Whitecastle, La., that William Jefferson, with other capitalists, will erect a sawmill in St. James Parish.

The Sessions Clock Company, Forestville, Conn., will erect a new brick factory on the site from which it has moved its plant.

The Board of Trade at Caney, Kan., has signed a contract with Haller Brothers, of Coffeyville, for a window glass factory.

The Penn Cold Storage & Market Company will expend $75,000 in additions to its plant on Spruce, near Water street, Philadelphia.

Plans are being formulated at Walhalla, S. C., by W. J. Schroeder for the establishment of a mill to manufacture hosiery, etc.

Work is about starting on a seven-story factory building for the J. E. Tilt Shoe Company, Chicago, Ill. It will be 100x120 feet.

B. F. Shriver & Co., of Union Mills, Md., and elsewhere, are about to build a 240x67-foot canning establishment near Westminster.

Cleveland and Massillon, O., have been in

the race to get the Wheeling & Lake Erie Railway's repair shops that were burned at Canton.

A three-story and basement, 40x120-foot factory is about to be put up for R. A. Humphrys' Sons, cotton duck, etc., Philadelphia, Pa.

C. F. Hettinger & Co., Philadelphia, have been commissioned to prepare plans for a brewing plant in that city to cost about $200,000.

A 75x100-foot, three-story building is about being erected in Hoboken, N. J., to be used by the U. S. Rattan Company, Brooklyn, N. Y.

Contract has been let for a new foundry, brass or otherwise, for the American Stove Company's Schneider & Trenkamp division at Cleveland, O.

A company of Boston capitalists is purchasing from James F. Milhaus, property ten miles west of Selma, Ala., for a big cement plant.

The Old Colony Street Railway Company, which has an office in Boston, Mass., is to put in some large machinery at Fall River or thereabouts.

A four-story and basement factory, 109x122 feet, is to be built at Fiftieth and Poplar streets, Philadelphia, for the American Paper Bottle Company.

Plans have been posted for estimates for a five-story factory building, 90x177 feet, at Baltimore, Md., for McCormick & Co., manufacturing chemists.

The stove works of the Wehrle Company, Newark, O., have been damaged by fire. The concern, it is said, has a new plant which will soon be operated.

The Schwan Reduction Company, of East St. Louis, Ill., has bought 15 acres of land near Belleville, and it is rumored that an aluminum factory will be built.

A 136x95-foot, four-story building will be erected this year by the Massachusetts Mills, Lowell, Mass. Picking and carding machinery will be placed in it.

Pettibone, Mulliken & Co., manufacturers of railroad crossings, frogs, etc., Chicago, Ill., have purchased a plot of land to be improved with manufacturing buildings.

Retherford Bros. Company, Muncie, Ind., manufacturer of gas and electric fixtures, gas mantels, etc., contemplates a new building which is likely to be built this season.

The Coleman (Tex.) Oil Mill & Manufacturing Company has been formed by W. R. McClellan, Q. V. Henderson, P. P. Reynolds, C. M. Alexander *et al.*, to build a plant.

The J. George Leyner Engineering Company, Denver, Colo., maker of mining machinery, etc., is about to build at Littleton, a plant for its own use, to cost about $150,000.

The Colt's Patent Firearms Manufacturing Company, Hartford, Conn., has acquired the American rights for the manufacture and sale of the Vickers-Maxim automatic machine guns.

The United States Charcoal Iron Company, whose president is J. Jones Hudson, 605 Betz Building, Philadelphia, contemplates to establish an iron charcoal plant at or near Chester.

The Merchants' Association, Newcastle, Ind., has decided to raise the required bonus for the location of the Chicago Steel Manufacturing Company, which was burned out at Hammond.

The Niagara Falls Milling Company, of which F. F. McLaughlin, of Toronto, Ont., is one of the promotors, expects to have a $50,000 plant running at the Falls by August 1.

A new ariel ladder and a new boiler have been invented by Asia La France and another. They will probably be manufactured by the La France Fire Engine Company, Elmira, N. Y.

Ball Bros., proprietors of the Carthage (N. Y.) Tissue Paper Mills, will establish there a concern to be called the Empire Sulphite Pulp Company. Building is to begin about June 1.

John J. Cunningham and others are organizing to build a paper mill on the Saranac near Plattsburg, N. Y. Among them are W. J. Gallagher, of Sandy Hill, and O. H. Moore, of Fort Edward.

A syndicate headed by Frank Lawrence, of Omaha, Neb., will erect a plant at Alton, Ill., for the manufacture of finished lead products. A plant for the manufacture of shot and lead plate will be included.

The Seacoast Packing Company is expected to operate a big sardine factory in Robbinston, Me., this year. The Robbinston Packing Company will probably rebuild its plant, which was destroyed by fire last year.

The East Liverpool (O.) Potteries Company has bought a 213-acre tract of mineral land in Franklin County, Pa., or thereabouts, and proposes to develop it. Eventually a factory may be built at Willow Hill.

Plans have been completed for a factory building at Milwaukee, Wis., to take the place of one recently burned which was occupied by the Milwaukee Automatic Machine Company. It will be 60x150 feet, three stories.

The Power Specialty Company, manufacturer of boiler specialties, will move its plant from Buffalo, N. Y., to Detroit, Mich., with offices in the Washington arcade, while its Canadian branch, at Bridgeberg, Ont., will be moved to Windsor.

The Board of Trade, Walden, N. Y., is interested in forming a company proposed by Geo. and J. L. Schrade to manufacture pocket cutlery, razors and machinists' tools, and also "to introduce new methods of manufacture in labor-saving machinery."

Henry R. Dalton, Jr., has been elected president of the Baush Machine Tool Company, in place of W. H. Baush, resigned. C. J. Wetsel has been elected treasurer, in place of David Hunt, Jr., resigned. The company asks that all communications be addressed to Baush Machine Tool Company, Springfield, Mass.

A. C. Williams, proprietor of the Ravenna (O.) sad iron works, has absorbed the Sheehan Manufacturing Company, Salem, manufacturer of leather riveting machinery, and will move the machinery to Ravenna. He has let the contract for an additional building, 100 feet long.

The Pittston (Pa.) Brewing Company plans additions and improvements.

The Mesta Machine Company, Pittsburg, Pa., has begun to erect a large addition to its plant at Hays. The site is that formerly occupied by the American Bridge Company's plant, which is being removed to Ambridge.

Charles G. Smith Company, Pittsburg, Pa., as direct representative for Bullard Machine Tool Company, Becker-Brainard Milling Machine Company, P. Blaisdell & Co., Whitcomb Manufacturing Company, Safety Emery Wheel Company, Eastern Machinery Company, Mueller Machine Tool Company and Bath Grinder Company, has removed its offices to the Park Building.

Contracts have been let to erect two buildings at Chanute, Kan., for the Star Drilling Machine Company, of Akron, Ohio, at a cost of construction and machinery of about $75,000. There will be a machine shop, 60x120 feet, two stories and attic; a blacksmith shop, 48x60 feet, and the building that is now used for a wareroom will be converted into a wood-working shop.

The American Watch Tool Company, Waltham, Mass., has reacquired from the Loop-Lock Machine Company its former factory plant and all the assets appertaining to the manufacture of watch tools, precision and automatic machinery, watchmakers' lathes and attachments, and proposes to devote its entire time to this class of machinery. In the future all communications should be addressed to American Watch Tool Company, Waltham, Mass., which title it again assumes as a Massachusetts corporation.

The Perkins Machine Company, South Boston, Mass., manufacturer of all kinds of presses, states that business with it is very good and it has booked a number of foreign orders the past month. The volume of its trade has increased so that it had to have more room and has just purchased five acres of land in Warren, Mass., on which is a machine shop, 300x80 feet, with electric traveling crane; also a foundry, 110x60 feet; a pattern shop, 100x40 feet; together with blacksmith shop and other small buildings. The company intends to run the plant by Westinghouse motors. Two electric cranes are to be in operation, one in the machine shop and one in the foundry, of 20 tons capacity; the foundry and the machine shop to be connected with the cranes, which run 132 feet between buildings. Patterns are to be taken to the foundry by a small electric trolley. In fact, every motion, where possible, is to be done by electricity. There is over 800 feet of siding on the premises. The company expects to be running in the new plant by May 1.

Since the removal of the foundry and pattern departments from the B. F. Sturtevant Company's plant at Jamaica Plain to its extensive new quarters at Hyde Park, Mass., the moving of the other departments has progressed in earnest. The fan, heater and electrical departments have already been moved, and the engine and galvanized iron department are in process of removal and the erection of the machines in the machine shop is well under way. These machines, as well as all the others throughout the works, will be of the most modern and improved type, and with the systems of cranes and industrial railways will enable the work to be turned out accurately, rapidly and at a minimum cost. The handsome office building is rounding into shape. The standing finish, quartered oak on the first and second floors and plain oak on the third and fourth floors, is completed, and the walls and ceilings are being tinted. The headquarters are still at Jamaica Plain, but in a few months the entire plant will be moved.

New Catalogs.

The Paris Plow Company, Paris, Ont. 1904 catalog of Paris plows. Illustrated. 6x9, pp. 46, paper.

The Hasbrouck Motor Works, Inc., West Mystic, Conn. Hasbrouck motors for marine service; auto boats and launches. Illustrated. 5x8, pp. 15, paper.

Buffalo Forge Company, Buffalo, N. Y. "Mechanical Induced Draft" and "Volume Blowers and Exhausters," two neatly arranged and well illustrated 3½x6½ booklets.

The Jeffrey Manufacturing Company, Columbus, Ohio. Circular No. 77, descriptive and illustrative of the Jeffrey grab bucket and grab bucket systems. 3½x6, pp. 12, paper.

The Whitney Manufacturing Company, of Hartford, Conn., has issued a small book describing its roller chains, sprockets, etc., which, besides being in the nature of a catalog, contains a good deal of information regarding standards in chain construction and the making of sprocket wheels. It is sent to anyone interested. 3¼x6, pp. 19, paper.

A. D. Quint, Hartford, Conn. 1904 catalog of Quint's vertical turret machines, including 32-inch, six-spindle turret machine for boring, drilling and tapping; four-spindle vertical turret milling machine; turret chucking machine; four-spindle turret drill, for drilling, reaming and tapping; six-spindle turret drill, arranged for tapping; eight-, ten- and twelve-spindle turret drills; and No. 1 friction six-spindle turret drill. Each machine is illustrated and described. 6x9, pp. 24, paper.

The Crocker-Wheeler Company, Ampere, N. J., has issued a series of flyers, or pamphlets, which will be of value to anyone interested in the application of motor drive to machine tools. There are sixteen of these flyers, and each one shows some representative and well-known make of machine tool driven by Crocker-Wheeler motor, the illustrations being from actual photographs. This interesting series will doubtless be sent to machine tool builders and users and others interested upon application.

Atlas Car & Manufacturing Company, Cleveland, Ohio. Catalog No. 1018 of mine and ore cars. There are illustrated many types of dump cars for smelting and roasting plants, furnaces, foundries, cement works and general use; charging barrows, coal and coke wagons, dumping buckets, overhead trolleys, industrial railway equipment, frogs, switches, rail, etc. The catalog, copiously illustrated throughout and containing much descriptive matter, should be of value to those interested in this line of products. 6x9, pp. 101, paper.

The Triumph Electric Company, Cincinnati, Ohio. "Electrical Machinery" is the title of quite a handsome catalog we have received from this company. The design and construction of the direct-connected generators, belted generators, motors and special machines made by the Triumph company are illustrated in detail and amply described. A number of fine illustrations are shown of applications of motor drives to representative machines in the machine shop, printing office, wood-working shop, rolling mills and other miscellaneous service. The catalog is printed in two colors on coated paper, and is illustrated throughout by fine half-tones. 8x10, pp. 61, paper.

Fairbanks, Morse & Co., Chicago, Ill. 1904 catalog of hoists and mining machinery operated by gasoline, naphtha, distillate, kerosene and crude oil, including geared hoister, with special illustration of clutch mechanism; vertical geared hoist; combined gasoline engine and double drum tandem hoist; sectionalized gasoline hoist, with illustration of the hoist as knocked down for mule-back transportation; flat friction hoists, with special view of starter pump; prospecting plants; plants for small mines, etc. The various types of apparatus shown are well illustrated by photographs, and the details of construction are dealt with fully in the text. This company also builds flat friction and geared hoists and other mining machinery operated by steam. 6x9, pp. 32, paper.

J. H. Williams & Co., Brooklyn, N. Y. Drop forgings. In addition to the well-known line of drop-forged specialties made by this company, such as wrenches, handles, gages, hooks, crank shafts, etc., this 1904 catalog includes several additions to the line of last year. Among these are external-gage forgings (page 61), made to conform in size and design to the external forgings (pages 59 and 60), which have been on the market about a year; and hexagon box wrenches (pages 22-3), both single and double end, designed particularly for use where nuts or screws are in close corners or places requiring a wrench with a small head. The catalog is printed in two colors and is profusely illustrated throughout. 5x7½, pp. 103, with attractive and appropriate cover effect.

Miscellaneous Wants.

Advertisements will be inserted under this head at 25 cents a line each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Caliper cat. free. E. G. Smith, Columbia, Pa.

Punches & dies. Wal.M.Wks., Waltham, Mass.

Will buy or pay royalty for good patented machine or tool. Box 282, AMER. MACH.

Wanted—Patented specialties of merit. Address Power Specialty Co., Buffalo, N. Y.

Light and fine mach'y to order; models and elec. work specialty. E. O. Chase, Newark, N. J.

John Klola, general engraver; booklet cat. free. R. 59, 155 W. Madison st., Chicago, Ill.

Special machinery to order. Geo. M. Mayer, M. E., 1131 Monadnock, Chicago, Ill.

Automatic machinery designed and constructed by the Wellman Sole Cutting Machine Co., Medford, Mass.

Wanted—Machinery or machine parts to build by contract or day work; good facilities; charges reasonable. Address A., care AMERICAN MACHINIST.

Wanted—Men to fill positions in shop and office; we always have openings; list your name where it will benefit you. Harrisburg Registry, Harrisburg, Pa.

Wanted—Partner with capital to build an air ship of best construction; model and drawings ready; patent applied for. Address G. S., care AMERICAN MACHINIST.

Firm in Spain wants machinery for lead sanitary siphons; continuous pipe process; no casting in mold, in order to obtain a polished internal surface. Box 346, AM. M.

Wanted—To correspond with strong company that would add new line of work on royalty; shop equipped for engine manufacture preferred. Major Downs, South Bend, Ind.

We desire an agent in every shop in the United States to handle our technical books; a wide-awake man can do very well; only one in a shop. The Derry-Collard Co., 256 Broadway, New York.

Wanted—A practical manufacturing machinist, with from $1,000 to $10,000, to take an active interest in the manufacturing end of an established business; the object not capital, but brains and management in turning out the work. Address Box 258, AM. M.

A young gentleman interested in mechanical matters, having $50,000 to $100,000 to invest, and who would be willing and capable of taking an active part in a well-established and profitable machine-tool business, located in the East, could learn the details by addressing Box 377, AMERICAN MACHINIST.

Automobiles.—M. E., automobile specialist, man of brains, honest, energetic, having completed full designs and specifications of most modern car, offers machine tool builder start at once manufacturing automobiles; association basis; financial success guaranteed; open for thorough investigation. "Designer," care AMERICAN MACHINIST.

Wanted.—Have well-equipped, up-to-date machine shop specially fitted for manufacturing high-grade light machinery, electrical instruments, etc., and would like some first-class specialty to manufacture on contract; models built; inventions developed; gears cut; punches, dies and special tools made to order. Page Machine Co., No. 812 Greenwich st., corner Jane st., New York.

For Sale.

For Sale—Tools and patent for a sheet-metal hand-wheel; a good thing. J. L. Lucas, Bridgeport, Conn.

Motor cycle gasoline engine blueprints and castings for sale. L. T. Barnes, 75 Truxton st., Brooklyn, N. Y.

For Sale—Patent No. 749,544, granted Jan. 12, 1904, Ermo pipe wrench; this will bear investigation. Address W. H. Ermentrout, 514 Elm st., Reading, Pa.

For Sale—Disk grinder, single end, special table, nearly new; photo and description. L. Robbins, Worcester, Mass.

"Crescent" reversible speed propellers for launches and sailing crafts; 2, 3 and 4 bladed; East shop right for sale. Duluth Gas Engine Works, Duluth, Minn.

Several second-hand motors and dynamos, also 15 horse-power Backus gasoline engine; all practically equal to new; at low prices. Address E. G. Bernard Co., Troy, N. Y.

For Sale—17 vols. AMERICAN MACHINIST, from 1887 to 1903, inclusive, in good condition; only four numbers missing; all indexes; also 35 numbers of Vols. 7, 8 and 9; Vol. 21 neatly bound in cloth; price for all $50, f. o. b. Address T. Maker, care AM. M.

The designer and owner of a machine that has proven its ability to turn out more and better work than any now on the market, wishes to place its manufacture in the hands of parties with sufficient capital and facilities to handle 15 ton weight of finished machine; expectations of personal return are reasonable; ready to be associated in the manufacture if desired. Box 161, AMER. MACHINIST.

Manufacturing Plant for Sale.—We offer for sale, or lease if desired, the plant at the corner of 12th and French streets, which we are now vacating for our new works on the western city limits; equipped with power, cranes, tool foundations, shafting, hot air heating system, electric light plant, etc.; foundry in connection; suitable for medium or heavy manufacturing. Address Ball Engine Co., Erie, Pa.

An Investment Opportunity.—A limited number of shares of stock in a machinery manufacturing concern organized to absorb and to enlarge an old-established paying business, will for a short time be offered for sale. This institution is unique, in that it will have no watered stock and will give away no stock for promotion. It is a safe, round, paying proposition; best of references; write quick. Address P. O. Box 498, Stockton, Cal.

Wants.

Situation and Help Advertisements only inserted under this head. Rate 25 cents a line for each insertion. About six words make a line. No advertisements under two lines accepted, and no advertisements abbreviated. The cash and copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded; but replies will not be returned. If not forwarded they will be destroyed without notice. Original letters of recommendation or other papers of value should not be enclosed to unknown correspondents. Only bona-fide situation want or help want advertisements inserted under this heading. Agency advertisements must be placed under Miscellaneous Wants.

Situations Wanted.

Classification indicates present address of advertiser, nothing else.

CONNECTICUT.

Executive position wanted; age 38; a practical toolmaker; technical; 10 years in charge of finest manufacturing. Box 369, AMERICAN MACHINIST.

A native American mechanical engineer of education and experience desires correspondence with a view to a position as master mechanic, chief engineer or superintendent of power and plant. Address Box 328, AM. M.

ILLINOIS.

Engineering salesman; mechanical or electrical line; graduate in mechanical and electrical engineering; 28 years of age. Box 370, AMERICAN MACHINIST.

Mechanical draftsman, first-class designer, graduate, desires position; familiar with steam shovels, hoisting engines and rolling-mill work; shop experience; A1 references. Box 373, AMERICAN MACHINIST.

Machinery salesman, first class, desires to make a change; am practical machinist; can furnish unquestionable references and show successful record; would like to assume charge of sales department; prefer Eastern territory. Box 340, AMERICAN MACHINIST.

MASSACHUSETTS.

Draftsman, long shop experience; designer jigs, fixtures, automatic machines. Box 357, AMERICAN MACHINIST.

Experienced mechanical draftsman, shop experience, wishes change for permanent position, in or near Boston. Box 384, AM. M.

MICHIGAN.

Practical shop man desires position as assistant superintendent or general shop foreman; modern tool methods; interchangeable systems; small work; reference. Box 381, AMERICAN MACHINIST.

NEW HAMPSHIRE.

Position as foreman or operator on automatic and hand screw machines; 8 years' experience. Box 341, AMERICAN MACHINIST.

NEW JERSEY.

A1 stationary engineer and machinist wants position; N. Y. or J. C. Box 294, A. M.

Technical graduate, 15 years' experience in responsible positions with well-known concerns engaged in medium and heavy machine work, desires connection in managing capacity. Box 353, AMERICAN MACHINIST.

High-grade man, 28, desires change; 8 years' machine-manufacturing experience, 5 years as general shop clerk and works manager; now employed as general office man; familiar with machinery, shop details and cost; all-around office man and correspondent; some good

knowledge of advertising; ambitious, brainy and an enthusiastic worker; want some chance for advancement. Address "Executive," care AMERICAN MACHINIST.

NEW YORK.

Mechanical-electrical draftsman desires a position. Box 350, AMERICAN MACHINIST.

Milling machine man, 12 years' experience, would take charge. Box 375, AMER. MACH.

Experienced, reliable machinery man wants responsible office position. Box 365, AM. M.

Up-to-date mechanical superintendent desires change; A1 references. Box 383, AM. M.

Wanted—An experienced machine shop foreman; up-to-date methods; day or piecework systems; engine work a specialty. Box 343, AMERICAN MACHINIST.

Position with bolt manufacturer; 23 years' experience with Russell, Burdsall & Ward, as patternmaker on automatic bolt and nut machinery; West preferred; A1 references. Box 371, AMERICAN MACHINIST.

Mechanical draftsman, German (25), technical graduate, with 11 years' experience in shop and drafting room, wants to leave New York; would take a position as machinist only, to get a chance. Box 364, AM. MACH.

OHIO.

Draftsman; shop experience since 1890; neat; rapid. Box 1063, Mechanicsburg, O.

Sheet metal machinery designer, M. E., 8 years' shop and office experience, desires change; excellent references. Box 379, A. M.

Graduated mechanical engineer (28), experienced designer, automatic machines, machine tools, wants responsible position. Box 380, AMERICAN MACHINIST.

Practical, experienced man of business and executive ability seeks position in charge of shop or drafting room; native American; expert on Corliss, pumping or blowing engines, special and labor-saving machinery and power stations. Box 359, AMER. MACHINIST.

PENNSYLVANIA.

Mechanical draftsman, German, 26 years, technical graduate, 3½ years' experience in drafting and designing, also shop experience, wishes steady position. Box 382, AM. M.

Toolmaker with technical education and extensive experience at designing and building, special machinery tools, and fixtures, wishes to locate in Central West. Box 374, AM. M.

Mechanical engineer, draftsman, age 28, Polytechnic Institute graduate of Germany, with 8 years' shop and drafting-room experience in steam engines, automobiles and all kinds of machinery, desires change; any State of U. S. A. Address Box 386, AM. M.

Help Wanted.

Classification indicates present address of advertiser, nothing else.

CANADA.

Wanted—First-class toolmakers; position permanent to suitable men. Ross Rifle Co., Quebec, Canada.

Wanted—First-class case-hardener; position permanent to the right man. Ross Rifle Co., Quebec, Canada.

Wanted—A first-class gun barrel straightener; Englishman preferred. Address application to Box 378, AMERICAN MACHINIST.

Wanted—An assistant foreman for a machine shop producing light, interchangeable parts; must be thoroughly up-to-date; a hustler and a good handler of men; give references; position will pay $4 per day. P. O. Box 603, Guelph, Canada.

ILLINOIS.

Wanted—A first-class machinist for inspector on high-speed engine details. Address Box 338, AMERICAN MACHINIST.

Wanted—Immediately, by large manufacturing corporation, competent and experienced designer for sheet metal working machinery; good place for right man; give full particulars and salary expected. Box 352, AMERICAN MACHINIST.

Wanted—Young man of technical education and practical experience, as assistant superintendent by a large engine manufacturer near Chicago; must be qualified to get highest efficiency from machines and tools in the way of production; permanent and excellent opening for young man of brains and energy; state age, experience and salary expected. Box 358, AMERICAN MACHINIST.

INDIANA.

Wanted—Machine shop foreman; principal product of factory is wood-working machinery; good pay to proper party; references required. Address Box 319, AMER. MACHINIST.

MASSACHUSETTS.

Wanted—An all-round turret machine man; one used to Cleveland automatic screw machine preferred. Address Boston Gear Works, Boston, Mass.

First-class superintendent or foreman, capable of taking charge of a plant manufacturing machine screws; must be a good handler of men and understand the setting up and operating of hand and automatic screw machines; first-class opportunity for the right man; in answering, state experience, give references and salary expected. Box 363, AMERICAN MACHINIST.

NEW YORK.

Wanted—Experienced, educated machinist, age about 30, as assistant foreman; one with ability to take charge and handle men and reduce operating expenses; to such a man advancement and an interest will be given. Address Box 372, AMERICAN MACHINIST.

Wanted—A first-class foreman machinist of good executive ability, foresight and ingenuity, and a thorough experience in the best methods of rapid and economical production of interchangeable work, especially in small engine and general machinery manufacture. Apply, giving full particulars to Box 368, AMERICAN MACHINIST.

OHIO.

An experienced designer of bolt and nut machinery; none but high-grade men need apply. Box 366, AMERICAN MACHINIST.

Wanted—10 machinists on small, close work; town of 8,000 inhabitants; 30 cents per hour, also premium work; permanent positions for first-class men; no transportation paid; in answering, state whether union or non-union. Apply to W. J. Burt, Niles, O.

PENNSYLVANIA.

Wanted—First-class floor hands for erecting air compressors and engines. Box 367, AMERICAN MACHINIST.

Wanted—Foreman for machine shop to take charge of operating the machine tools; state experience and where employed. Box 376, AMERICAN MACHINIST.

The Monotype Company maintains a school to train young men to meet the constantly increasing demand for operators of its type casting and composing machine. These operators have done so well that it receives more applications for places than can be filled. In making selections these qualifications carry most weight: common sense, type foundry experience, printing office experience, automatic machinery experience. Full particulars will be furnished to inquirers who furnish the same information about themselves. The Lanston Monotype Machine Co., 1231 Callowhill st., Philadelphia, Pa.

VERMONT.

Patternmaker on machine tool work; state experience, references and wages. Box 385, AMERICAN MACHINIST.

WEST OF MISSISSIPPI.

Wanted—Three first-class patternmakers; steady work. Address A-10, AMERICAN MACHINIST, stating wages expected.

WISCONSIN.

Foundry foreman for foundry running 30 molders on general machinery castings; location, Milwaukee. Address A. B. C., care A. M.

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Scotch Design of Variable Speed Lathe.

We show herewith several illustrations of a new line of lathes made by John Lang & Sons, of Johnstone, Scotland, the leading feature of which is the incorporation of a variable-speed drive in place of the usual cone pulley.

Fig. 1 shows a 10-inch center (20-inch swing) triple-geared lathe, and Fig. 2 shows a top view of a turret lathe with the gear covers removed. The variable-speed feature will be seen to be essentially that of a Reeves countershaft, which, however, is enclosed in the headstock. The operation of the cones of this device is by the hand-wheel in front of and near the right-hand end of the headstock. The turning of this hand-wheel also operates an index, seen projecting through a slot in both illustrations, which index faces a graduated scale marked in diameters of the work and the setting of the index to any graduation insures a surface speed of 30 feet per minute for work of the diameter indicated. In the case of Fig. 2 another innovation is shown—a pair of covers over the slide surfaces of the lathe bed, the object of which is to protect the surfaces from chips.

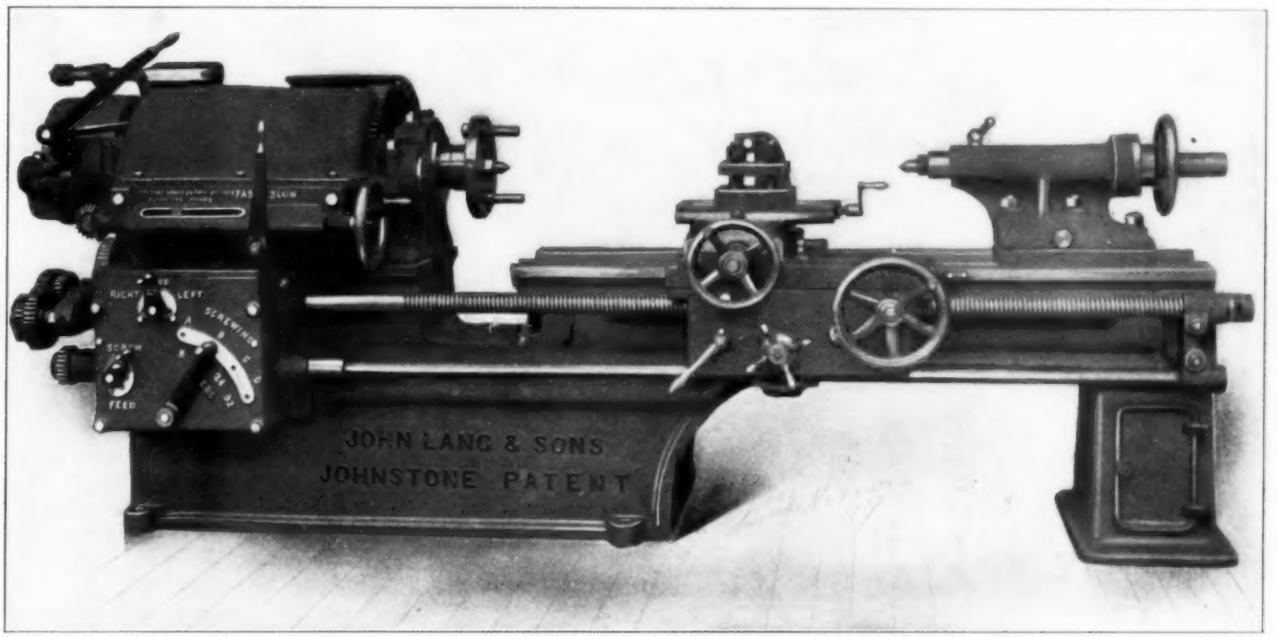


FIG. 1. GENERAL VIEW OF VARIABLE SPEED LATHE.

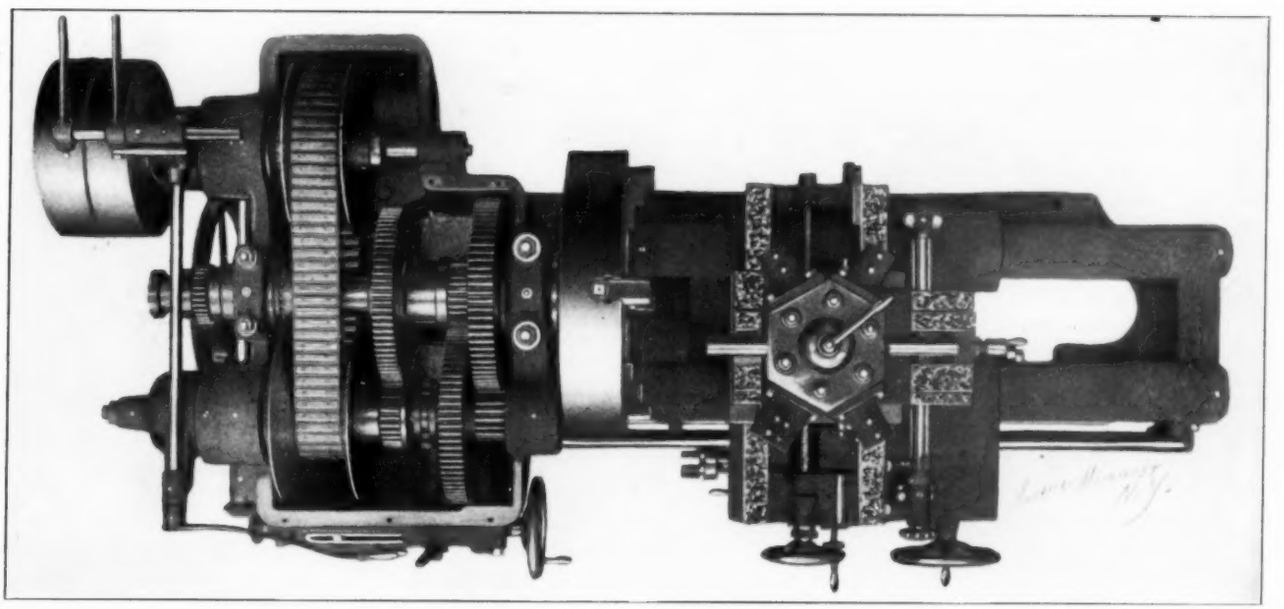


FIG. 2. OVERHEAD VIEW OF HEADSTOCK MECHANISM.

In the case of lathes intended for facing the adjusting hand-wheel is connected to the cross-feed screw, making the movement of the former automatic, the speed of the machine automatically increasing and maintaining a constant surface speed at the cutting point as it approaches the center.

This arrangement is included in the special shell pointing lathe shown in Figs. 3 and 4, which has other interesting features. The tool point traverses the arc of a circle, the radius of which is adjustable by the cross-slide shown in Fig. 4, while different diameters of shell are accommodated by the cross-slide seen in Fig. 3. The adjustment for various lengths of shell is obvious from Fig. 4. The shell is gripped in a chuck which forms part of the lathe and is manipulated by the pilot-wheel seen in Fig. 3, the frame of which swings upon a bolt to permit engagement and disengagement of the worm.

Countershafts are not required nor used, the first-motion shaft of the lathes carrying the tight and loose pulleys as shown in

the illustrations. The machines are of new design throughout and are made, as full engine lathes, of 12, 16, 20 and 24, and as surfacing and boring lathes of 24, 30 and 36 inches swing.

Gasoline Engines for Fast Boats.

BY HERBERT L. TOWLE.

A little less than five years ago, in the AMERICAN MACHINIST of October 12 and 19, 1899, I called attention, under the title "The Gasoline Engine in Boats," to certain possibilities in the way of increasing the power and speed of the gasoline launch. A popular type of steam launch was taken as the starting point, and comparison was made with the gasoline launch of equal popularity at that time. It was remarked that the steam equipment complete—boiler, engine, fittings and water in the boiler—would weigh 100 pounds or more per horse-power, and the gasoline engine about the same. The inquiry then propounded, whether a gasoline boat could be built to beat the steam craft, altho it then had to be argued rather seriously, would if put to-day to an up-to-date launch builder, most probably be taken as a humorous effort, in view of the fact that excellent marine motors are already to be found weighing no more than 20 pounds per horse-power, a figure which no marine steam equipment is likely ever to reach.

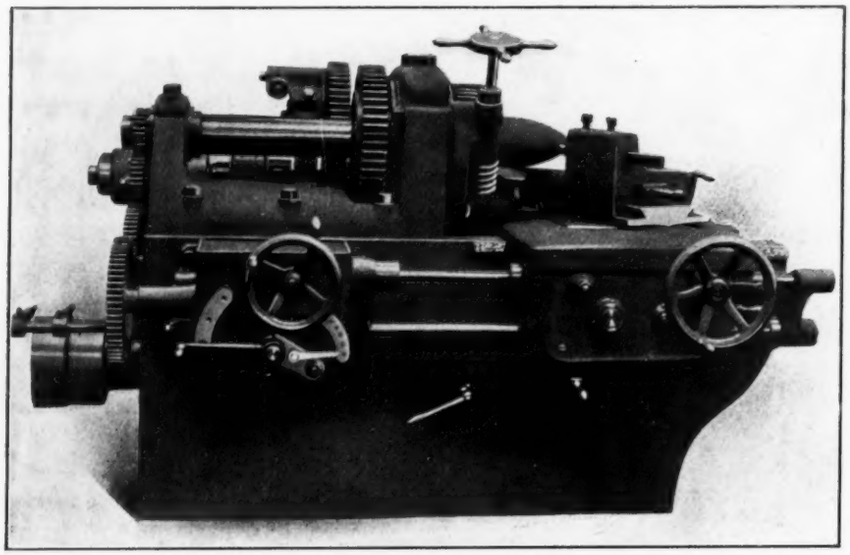


FIG. 3. SPECIAL SHELL POINTING LATHE.

The article above referred to was devoted chiefly to an analysis of piston vibration, and to a comparison of the vibratory effects of two-, three- and four-cylinder motors. It was rather premature at the time of its publication, because there was then no demand for boats conspicuously better than the type then prevailing; but it is a little curious to note how exactly the main points of the argument then set forth have been followed out in what has now become current practice in three-, four- and six-cylinder automobile motors. For the surprisingly sudden growth in the demand for small craft of the highest possible speeds, the automobile is no doubt largely responsible, as it most certainly is for the development of an engine by which it is possible to satisfy the demand. Indeed, it may be said that the art of high-speed engine designing, remote as it looked five years ago, is to-day much more nearly reduced to a science than is the art of designing hulls of a sort to accommodate these same motors. One must candidly confess that some examples of hull design both fearful and wonderful have been presented to the public within the last few months; and one may, without straining a point in his mental attitude, begin half to sympathize with those disgusted builders of the older types of launches who are declaring that the builders of "automobile boats" know as little about boat building as they themselves do about automobiles. This, however, is a transient situation, which will correct itself in the course of a couple of seasons, if the builders of fast boats are given a free hand to work out suitable designs. Meanwhile, with all respect to the very competent builders of hulls, who have clung too long to their heavy engines, it may be pointed out that, since the initial step toward developing a high-speed type of boat has been left to the automobile builders, the interests of the sport will be better conserved by awaiting the success of their endeavors to produce hulls to match their motors, than by berating them for not having been "instant in season" in both branches of design.

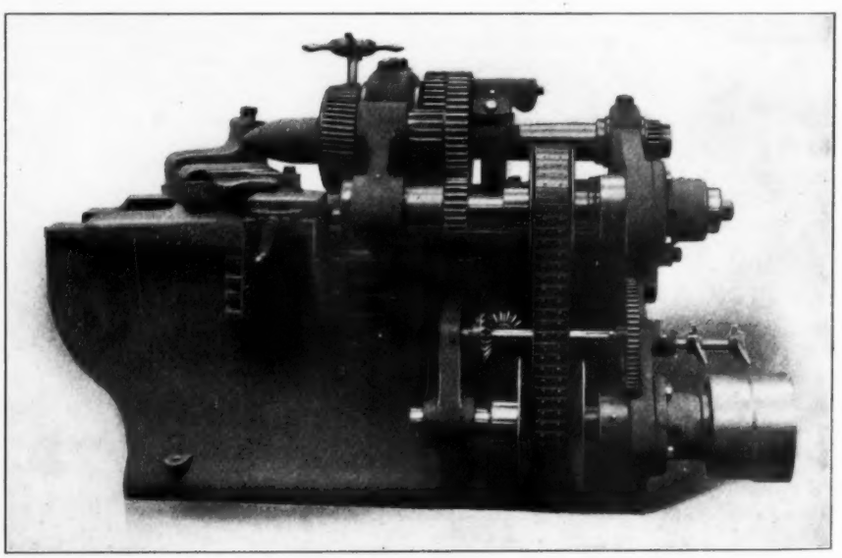


FIG. 4. REAR VIEW OF SHELL POINTING LATHE.

The purpose of the present article, however, is not to discuss amenities between rival associations, but to point out certain reasons for believing that the high-power launch deserves to be set down as something more than a mere freak of fashion.

No doubt many persons, among both builders and owners of the common type of launch, maintain that the high-power boat will necessarily shake itself to pieces in a short time, and that for this reason, and also because of the excessive and rapid wear on all the running parts of its engine, it is a useless toy, uncomfortable, dangerous and short-lived. As a matter of fact, a good designer can put three to four times more power into a boat of given displacement than was customary up to about two years ago, with actually less vibration of the hull than was caused by the familiar two-cylinder vertical engine. This is done by the intelligent application of several principles, which may be stated about as follows:

(1) The explosion motor gives its impulses intermittently. The more rapidly these impulses succeed each other the smaller will be the range of vibration of the frames or of the boat as a whole. This is true even if the number of cylinders be not increased. A small high-speed motor will shake the boat less than a slower and larger motor of the same power. If now the number of cylinders be increased, the

impulses will occur correspondingly closer together, and if there be more than four cylinders one impulse will not yet have been spent before the next begins. The greater the number of cylinders, the smoother will be the turning moment, since the vibration due to the reaction of the engine and hull from the irregular torque of the impulses will be less as the curve of torque approaches more and more to a straight line.

(2) With three cylinders and cranks 120 degrees apart, the algebraic sum of the vertical inertia of all the reciprocating parts is at all times zero. The crankshaft, unless balanced, exerts what may be called a slewing effort, which without doubt strains the frames more or less; and altho I have not seen any three-cylinder engines with counterweighted cranks, it seems not impossible that this may come. With six cylinders and properly disposed cranks even this slewing tendency is neutralized. For this reason it may be laid down as a safe rule that six is the best number of cylinders for a boat of fairly high power.

(3) Where a somewhat lower speed is considered sufficient, a four-cylinder engine with cranks disposed as they are in automobile motors (*i. e.*, with the second and third cranks lying together, and the first and fourth 180 degrees from them) is quite possibly the best choice, altho the three-cylinder engine is nearly as good, and somewhat cheaper to build. The four-cylinder engine is not quite in perfect mechanical balance, and will shake the hull least when located—as it must be in the very fast boat—well forward.

(4) The lightest engine for its power, if the latter be high, will have not less than six cylinders. With this number the weight of flywheel required becomes merely nominal. A lighter engine can be built of a number of medium-sized cylinders than of a few large ones, largely on account of the difference in the weight of flywheel required. Equally important is the fact that the engine with numerous small cylinders will have a much lower center of gravity, which in turn will affect the entire hull design for the good. It is very undesirable to give the cylinder of an explosion motor a stroke shorter than the diameter of its bore; and this is another reason for using small cylinders and many of them.

(5) When, as in the two highest classes of the A. A. A. rules, we are confronted with the problem of building engines of 180 and 400 horse-power to go in boats respectively 50 and 65 feet long, it becomes highly probable that the best results will be gained by using two engines, and twin screws. With such enormous powers in light hulls the tendency is to list the entire boat in a direction opposite to that of the screw's rotation, and this list, which becomes very marked and uncomfortable with high power, will of course be entirely neutralized with twin screws turning in opposite directions.

It may be well here to remark, to forestall any possible protest of incredulity, that the horse-powers at which the engines of the various classes are rated under the A. A. A. classification are actually reached, and even somewhat exceeded, in automobile motors of the present time. Piston speeds of 1,000 feet per minute, altho certainly high, are really below those for which the motors of racing machines are habitually designed, while for mean effective pressures authentic tests have shown net values of upward of 70 pounds per square inch at full normal speed. These results have been reached, first, by the use of high compressions, which may be very high indeed if the motor is running fast enough; second, by great improvements in the vaporizers used, through which a much more homogeneous and uniform mixture has been secured than heretofore; and, finally, by scrupulous attention to the refinements of valve design, and location, of ignition timing, and of the details of construction and lubrication.

A more serious problem than that of how to get the power is that of maintaining it for prolonged periods without breakdown of the engine or cutting out of the bearings. It is true that the engines in question are not expected to exert their full power except for short periods during actual contests. At the same time, no one is going to be satisfied with a boat which falls short of the utmost limit of possibility in the way of endurance as well as speed. To accomplish this, the design, materials and lubrication of the bearing surfaces must be given the most careful attention, and I am frank to say that in my opinion the last of these will bear a good deal more attention than it has yet received in even the most successful automobiles. It is common, for example, to see the crankshaft of a high-power racing machine made with double the bearing surface on the crankpins that is found in the main bearings. This can only be due to failure to lubricate the former sufficiently, since if this were accomplished it would be quite proper to reverse the proportions.

In other respects also the simon-pure automobile motor does not fill the requirements of a marine engine. Its crankshaft and crankpin bearings are too inaccessible; its ignition system is not sufficiently reliable for use on the water; and it is not designed, as it should be, to deliver its utmost power at very high speed, and then to be successfully throttled down for continuous cruising, without too great a falling off in efficiency.

Regarding the speed of the screw, it may be remarked that the limit here, with due regard to efficiency, is certainly much above the 500 to 600 r. p. m. at one time regarded as the maximum shaft speed possible. At least two fast launches within my personal knowledge use shaft speeds upward of 900 r. p. m., and it seems wholly reasonable to suppose that 1,000 r. p. m. will before long be frequently met. The real limit is to be found in the phenomenon of cavitation—the formation of a partial vacuum forward of the screw when the pressure per square inch back of the blades exceeds that of the atmosphere.

With reference to the allotment of engine power to the different sizes of hulls, under the A. A. A. rules, it may be remarked that this was by no means done at random. Each size of hull was credited with a displacement known, from boats already built, to be well within the minimum limits of possibility. The weights of the engines were calculated or estimated from trustworthy data, and to each hull assigned an engine whose weight, if it were built as light as possible, should not be more than a safe fraction of the total displacement. Beyond the requirement as to the minimum width of beam, no other restrictions were imposed, it being considered that the art of building the high-speed boat is still too much in its infancy to make it prudent to impose any arbitrary limitation on the ingenuity of builders. Under the proposed rules the most efficient engine and the best designed hull will win. Perhaps, a few years from now, enough will be known about the actual performance of such boats to justify the use of a measurement rule and system of time allowance, but it is quite certain that no measurement rule which has so far been proposed meets the case.

A patent has recently issued from the United States Patent Office which is assigned to the people of the United States. The patent covers a process discovered by Dr. George T. Moore, of the Department of Agriculture, for the production of bacterial cultures used in inoculating soils for the successful cultivation of clovers of all kinds, alfalfa, soil beans, cow peas and many other similar members of the legume family. The patent is given to the people of the United States forever, in effect, and the object in doing so is to forestall any effort to patent such a process and by that means circumscribe the efforts of farmers to improve their soils by raising leguminous crops.

In erecting a large generator having a bed-plate to which the bearing pedestals were bolted, it was found that the shaft had no end-play. The erecting engineer accordingly had the bearings taken out and faced off to give the shaft the proper amount of end-play, and reported to the factory that the machine had been shipped defective in this respect. An investigation brought to light the fact that the middle of the bed-plate had not been properly supported by the foundations, and the bed-plate had sagged, tilting the two bearings and bringing them nearer together, so that the space originally allowed on the shaft for end-play was taken up. The bearings were of the self-alining type, so that this tilting had not interfered with the alinement of the bearings.—*Electric Club Journal.*

The Planing of Curved Surfaces—I.

BY HOWARD A. COOMBS.

Outside of the regular run of work in the ordinary machine-shop, two problems present themselves now and then, the first of which is the machining of a curved surface other than a circular arc, and second, the finishing of an arc-shaped surface on a piece of work too large for the lathe.

The operation of the first problem can usually be performed in the lathe by giving the tool a reciprocating transverse movement during each rotation of the work-piece, and the second can be met by modifying a planer so that the tool and work no longer move relatively in a straight line, but the first problem is included in the second when the work is too large for the lathe.

The milling machine, drill press, shaper and the other machine tools are more special in their functions, and while of course by their use a surface of almost any shape whatsoever can be produced, they will not be considered in this article, the purpose of which is to describe some of the attachments to and modifications of planing machines, the purpose of which is to adapt them to the finishing of curved instead of plane surfaces, and to this end reference has been had to the records of patented devices of the kind mentioned. Doubtless many other instances of planers rigged especially for such work have occurred, and indeed the files of the AMERICAN MACHINIST show such to have been the case. It is hoped that this article may call forth from some of the readers of the AMERICAN MACHINIST descriptions of such instances. The proprietors of jobbing shops have probably all had occasions when they were required to machine curved surfaces of a kind or size that prohibited its being done in a lathe, and it is hoped therefore that the following descriptions of machines and devices for doing such work may not only be of interest to such, but also of use in assisting them to devise ways and means for special jobs of the kind specified which may present themselves in future.

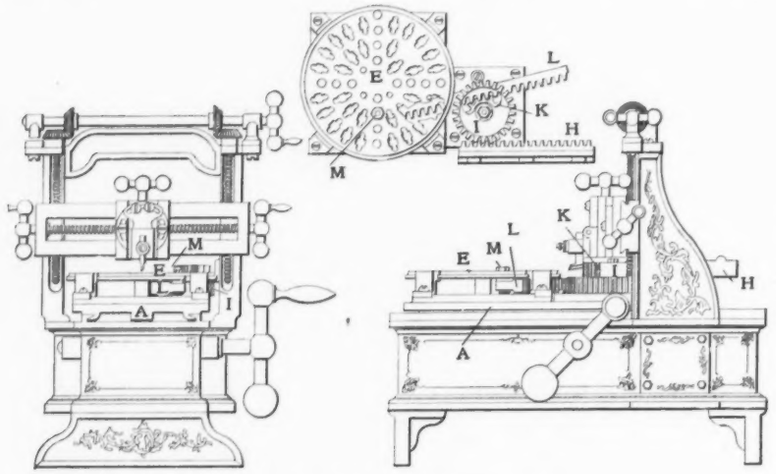
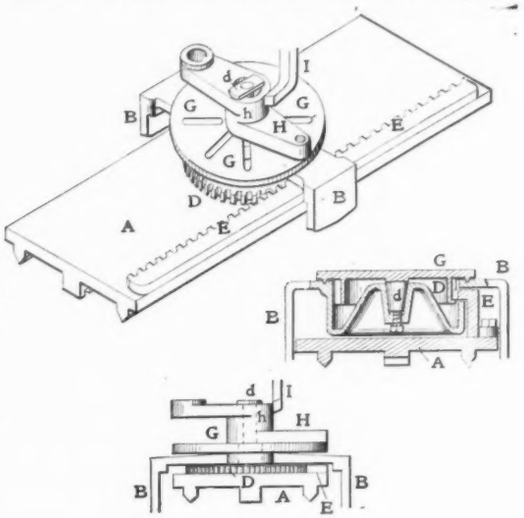


Fig. 1 Mellin's Planer Attachment-1854



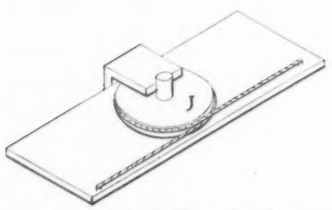
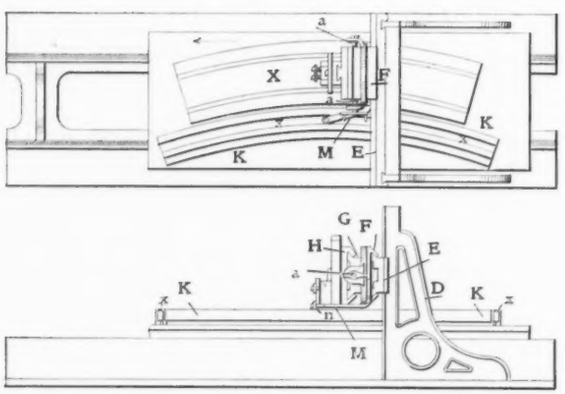


Fig. 2 Brastow & Zwiebel's Planer Attachment-1871



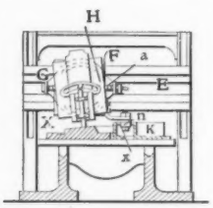
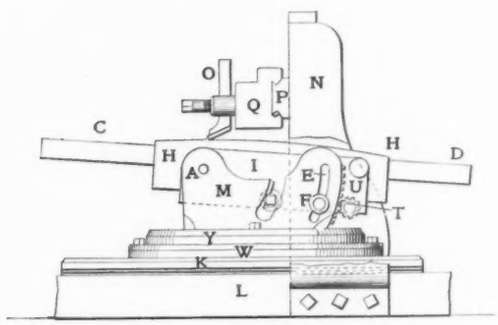


Fig. 3 Griffen's Planer Attachment-1872



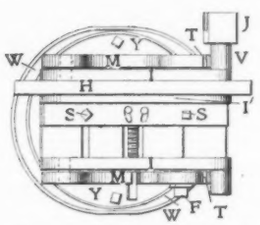


Fig. 4 Greenwoods Planer Attachment-1880

American Machinist

faces which was patented in the United States is shown as applied to a planer and also as removed, in Fig. 1. The patent was granted to D. F. Mellen in 1854, and is further interesting because the draftsman took the trouble to represent the filigree ornamental work with which machine tools built in the United States were wont to be decorated in those days. To obtain a curved surface by the use of the attachment the work is clamped on the rotatable support *E*, which has a rack *L* pivoted to its under side at *M*. A second rack is rigidly attached to the inside of the uprights, and the two racks mesh respectively with a pair of gears *I* and *K* attached together and supported on a vertical pin held in the table *A*. The travel of the latter beneath the tool causes the gears *I* and *K* to be rotated by the engagement of one of them with the stationary rack *H*, while the other gear of the pair causes a longitudinal movement of the rack *L*, and this gives an angular movement to the work support *E*, as will readily be seen. By changing the relative proportions of the gears and by setting pin *M* nearer or farther from the center of *E*, the radius of curvature of the path of the tool on the work may be greatly varied.

Fig. 2 shows a similar attachment, which was the invention of Louis C. Brastow and Alphons M. Zwiebel, of Wilkesbarre, Pa. The work to be machined, as will be seen by reference to the perspective view, is a double crank *H*. In order to finish the circular portion *h* of the hub on an ordinary planer, the tool of which is shown at *I*, the crank is mounted on a face-plate *G*, which has formed integrally therewith, or dependent therefrom the vertical spindle *d*, journaled in a frame *B*, extending across the table *A* of the planer and secured by its depending legs to the stationary bed. The construction and arrangement of this fixed frame *B* is clearly shown in the sectional view, from which it will be seen that the frame has, besides the vertical bearing for the spindle *d*, curved V-ways for the face-plate *G*. On a flange projecting downwardly from the face-plate is formed a spur gear *D*, the teeth of which are adapted to mesh with those of a rack *E* secured to the planer *A* and therefore reciprocating with it under the frame *B*.

As the table reciprocates, the rack *E* causes the face-plate and the attached crank *H* to oscillate or rotate backwards and forwards, to an extent limited, of course, by the adjustment of the usual dogs on the table. The peculiar shape of the frame *B* is for the purpose of holding a lubricant and, as shown in the lowest figure, a chain, cord or belt passing around a pulley *J*, taking the place of the gear *D* and rack *E*, may be employed, the ends of such chain, cord or belt being attached to the bed.

Fig. 3 represents an attachment to planers, patented by John Griffen in 1872, and which is shown as at work upon a segment *X* forming part of the circular track for the anti-friction rollers of a turntable. A segmental guide or templet *K* is attached to the planer table at the side of and concentrically with the segment *X*. The tool slide *F*, instead of being fed along the cross-rail *E* by means of a screw, is free to slide thereon and is controlled from the guide segment *K* by means of an arm *M* attached to the slide *F* and carrying a roller or block *n*, which is fitted in the groove *x* of the guide segment, the block *n* being located on the same radial line of segment as the tool. The slide *F* carries a swivel *G* to which in turn is fitted a slide *H* which can be fed along by means of a screw *a*. By this means the inclined surface of the segment can be finished off.

The next machine, illustrated in Fig. 4, is designed to cause the path of the tool in the work to be curved in vertical planes, the work being oscillated as it passes beneath the tool. To the planer table *K* is clamped a plate *W* on which is adjustably pivoted a plate *Y* carrying vertical side pieces *M*, between which is pivoted a chuck *I* having a movable jaw *I'* to clamp the work. The chuck *I* is hung on pivots *A* and a transverse shaft *V* journaled in the chuck *I* carries at its end a slotted socket *J*. To one of the uprights *N* is adjustably clamped a bar *C D* which engages in the socket *J*. By setting this bar at an angle, the movement of the table under the tool will cause the chuck *I* to swing on its pivot and consequently the work will also oscillate as it passes beneath the tool and the path of the tool will be a curve and, under proper adjustment, a circle the radius of which will depend on the angle at which bar *C D* was set.

Hardening Cast Iron.

The following from the specification of a recent United States patent speaks for itself. We give it to our readers as a matter of information and do not of course express any opinion upon it, although it will be noted that the inventors speak very positively as to the results obtained.

This invention relates to an improved process whereby cast iron in the rough or in the finished state may be hardened or tempered, *the hardness extending completely through articles of comparatively large dimensions.* The castings which are to be treated may be completely finished as regards machine work before they are hardened. The casting is first heated to a "cherry-red" heat. It is then dipped in a bath which consists of a practically anhydrous acid of high heat-conducting power, preferably sulfuric acid of a specific gravity of from 1.8 to 1.9, to which is added a suitable quantity of one or more of the heavy metals or their compounds—such, for example, as arsenic or the like. The preferable ingredients of the bath are sulfuric acid of a specific gravity of approximately 1.84 and red arsenic in the proportions of three-quarters of a pound of red arsenic crystals to one gallon of sulfuric acid. The castings may be either suddenly dipped in the afore-mentioned mixture and then taken out and cooled in water or they may be left in the bath until cool. We find, however, that by dipping the castings in the bath and holding them there for a time, which varies according to the size of the castings, and then completely cooling in water is quite as satisfactory and produces a material which is just as hard as if the castings were allowed to remain in the bath until cool, and the former method is preferable if a large number of castings are to be hardened, as the bath is thus prevented from becoming overheated. In preparing the bath when sulfuric acid and red arsenic are used we find that better results are obtained when the crystals are added to the sulfuric acid and the bath is allowed to stand for about a week before using, the reason probably being that the bath becomes more saturated with arsenical compound when the dissolved red arsenic has been long in the sulfuric acid.

It is found that in castings of comparatively large dimensions the hardening extends completely through the material, and thus the results obtained are far preferable to those obtained by what is known as "case-hardening." The change which takes place in the metal is in the nature of a molecular rearrangement or recrystallization coincident with an increase in the combined carbon at the expense of the graphitic carbon, and in this change lies the difference between the results by our bath and ordinary case hardening processes in which a certain portion of the carbon contained in the materials of the bath is actually given up to the metal.

It is found that the more rapid the cooling of the metal the harder it will become. For this reason the bath must be of high heat-conducting power, and this requirement is obtained by the use of the ingredients above referred to. The bath must further be practically free from water, as it is found that when the acid contains water in any considerable quantities a steam-cushion is formed between the acid and the metal, which prevents their coming in contact, with the result that the cooling is less rapid, and the iron is consequently not so hard. By having one or more of the heavy metals or their compounds dissolved in the acid the heat-conducting and heat-absorbing powers of the bath are considerably increased.

If you have any of those fire-pails with the round bottoms that won't stand anywhere, it will be well to take them on the quiet and bang the bottoms on the anvil until they are flattened enough to provide at least some semblance of stand-up-ability; then if the watchman is caught alone with an incipient fire, it will be possible to handle a dipper or to pull over a pile of rubbish to get at the fire without losing all the water. Pails that are good for nothing else are not the best for fire purposes.

The Turbine Centrifugal Pump.

For several years the Worthington branch of the International Steam Pump Company has been engaged in developing the centrifugal pump in order to increase its efficiency and adapt it to work under higher heads than has heretofore been feasible. The result is their Turbine Centrifugal pump of which we show several illustrations herewith.

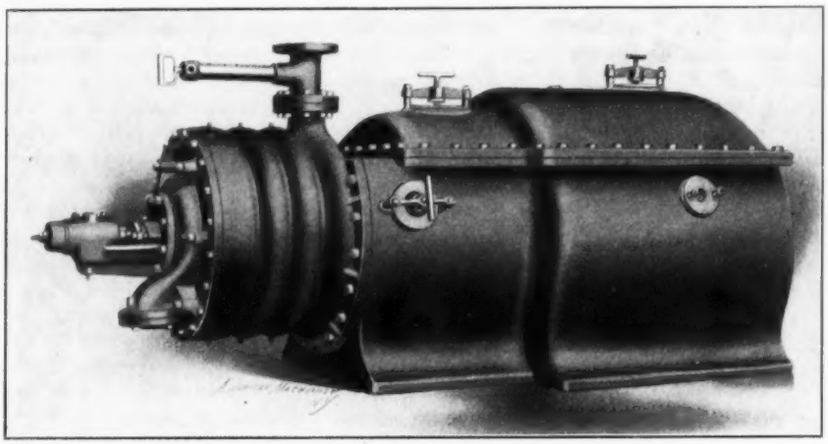


FIG. 1. MINE SERVICE PUMP TO WORK SUBMERGED.

Primarily, the chief departure from existing centrifugal pump construction lies in the adaptation of the construction of turbine water wheels with its action reversed to suit the reversed nature of the work. The usual construction is analogous to a turbine wheel without guide vanes, the water from the impeller vanes being discharged at high velocity into the comparatively still water in the chamber which encloses the impeller. In the turbine pump the water is delivered by the impeller vanes into a series of stationary diffusion vanes which correspond to the guide vanes of turbine wheels and which are so dispose[1] as regards angles and area of passage ways as to receive the water from the impeller vanes without shock and to gradually reduce the velocity to a low figure before delivering the water to the surrounding chamber. An additional feature is the construction of the pump to act in stages, a second impeller taking the water from the first, a third from the second, and so on. In this way these pumps may be made to act under heads as high as 2,000 feet.

Of the accompanying illustrations Fig 1 shows a four-stage pump installed in a gold and silver mine. It has a capacity of 200 gallons per minute against a head of 500 feet. The four-stage construction, as it appears externally, is clearly shown. An interesting feature of this pump is the enclosing of the motor in a water-tight case to permit its working when submerged even to a depth of several hundred feet. Another adaptation to mine service is shown in Fig. 2, which represents a sinking pump used in sinking shafts. The two peculiarities of this service are the uniformly dirty nature of the water and the fact that the head against the pump

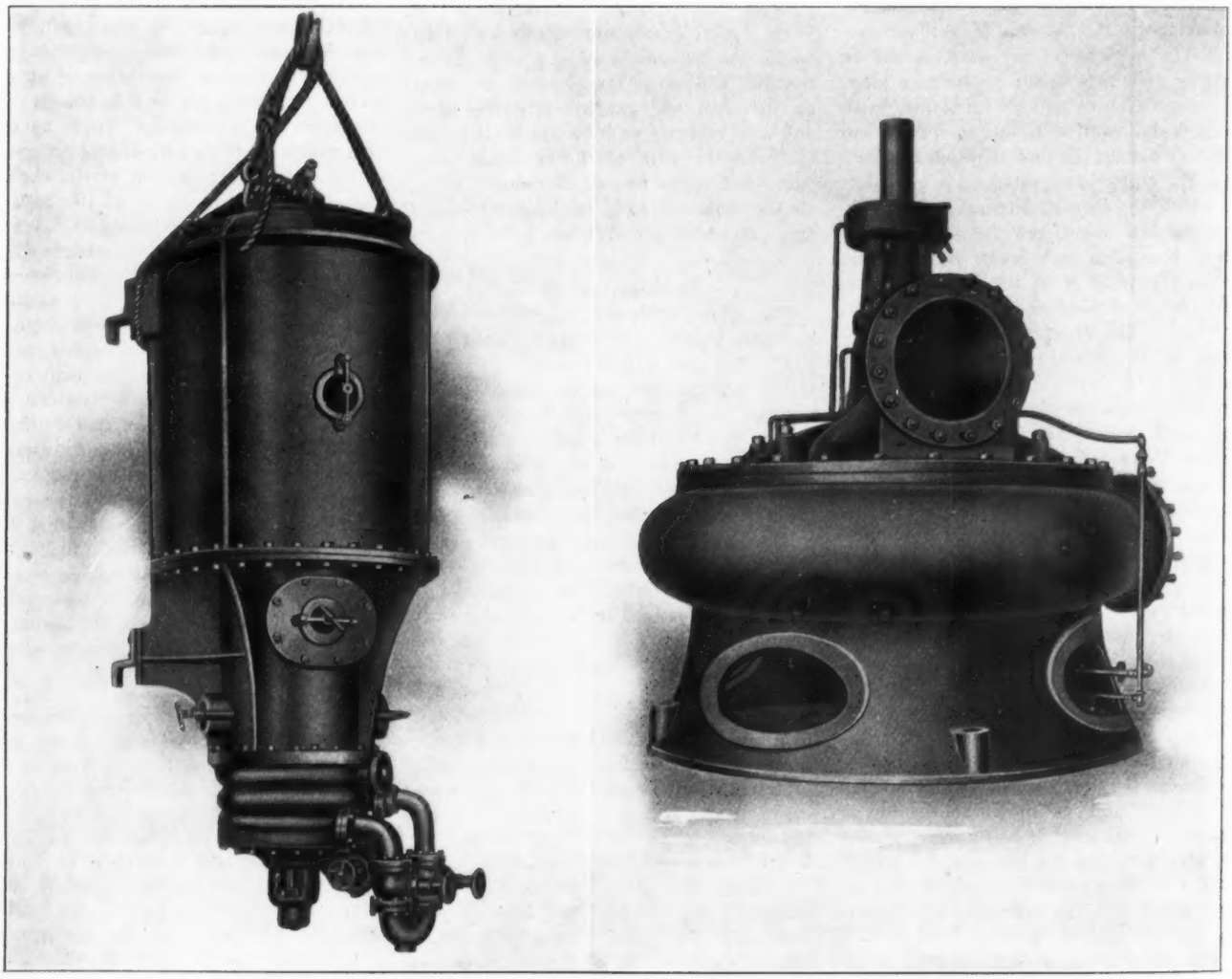


FIG. 2. SHAFT SINKING PUMP.

FIG. 3. WATER WORKS PUMP.

constantly increases as the shaft gets deeper. The centrifugal pump having no fitted rubbing parts working in the water is obviously peculiarly well fitted to dealing with dirty water and to adapt the pump to work under varying heads an arrangement of valves and by-passes is provided by which one or more of the stages may be thrown out of action. The pump shown is adapted to work in three stages under 300 feet head, each of the stages doing one-third of the work. The capacity is 200 gallons per minute. This pump also is completely enclosed in a water-tight case—a provision that is necessary to meet the vicissitudes of shaft sinking.

Fig. 3 shows a remarkable pump of which two have been supplied to the water works of Schenectady, N. Y. The head in this case gives a pressure of 120 pounds per square inch which, while high for a centrifugal pump, is not so high as to call for the stage construction. Each of these pumps has a capacity of twelve millions of gallons per day and absorbs eight hundred horse-power which is supplied by a General Electric motor.

The pumps have already been supplied to other classes of service involving work under high pressure including boiler feeding and elevator service.

For duty under low-pressure conditions the turbine and multiple stage constructions are omitted, and for this class of work two classes of pumps have been developed. Of these the first is called the Volute, which is more nearly analogous to the usual construction. One of these having a capacity of 3,000 gallons per minute under 60 feet head has been supplied to the Louisiana Purchase Exposition for pumping sewage.

The third class is the Conoidal, which differs from the Volute chiefly in its proportions which are so modified as to reduce the speed and adapt the pump to direct connection to electric motors under conditions where that would not be possible with the Volute type. The changes made are chiefly an increase in the axial length and a reduction in the diameter.

Fig. 4 shows graphically the results of a test of a 6-inch pump under varying conditions of head and delivery, and tells its own story.

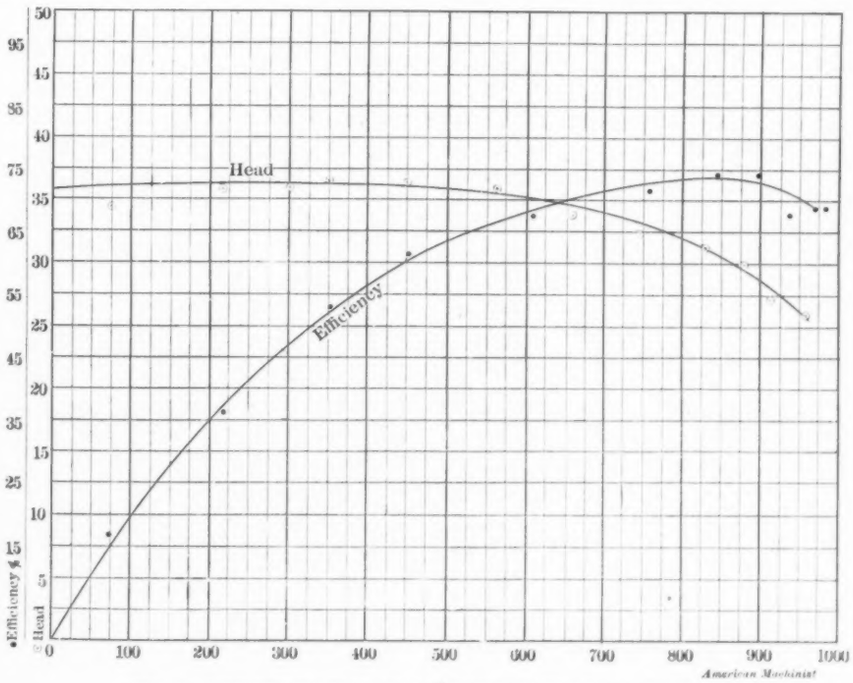


FIG. 4. EFFICIENCY TEST OF A 6-INCH CENTRIFUGAL PUMP.

An English Perpetual Motion.

We find in our English contemporary, *The English Mechanic and World of Science*, the following:

"PERPETUAL MOTION.

"[186.]—The inclosed is from the *Manchester Evening Chronicle* of this date. I think it would interest the readers of the *English Mechanic* if it can be published.

"THOS. HARDWICK.

"Lily Bank, Timperley, Cheshire.

"Perpetual Motion: Another Solution.

"The following letter has been sent to us with the accompanying diagram:

"'We have noticed in recent issues several articles on perpetual motion, all saying that it has been discovered, but never giving any details or even suggesting how it works. This makes one feel justified in ridiculing it; but we inclose a drawing of a small model which has been working without ceasing now for months. We think a careful examination of the drawing will settle all doubts as to its being a genuine motive power on one side. The corks are fastened to a thin tape or string which rotates round the two pulleys, which in turn drives any desired work geared to the pulley not immersed in the mercury. The mercury being heavier than the water prevents any escape of water. We hope you will find space for this, as an enlightenment to those who have only read the previous articles on the subject.

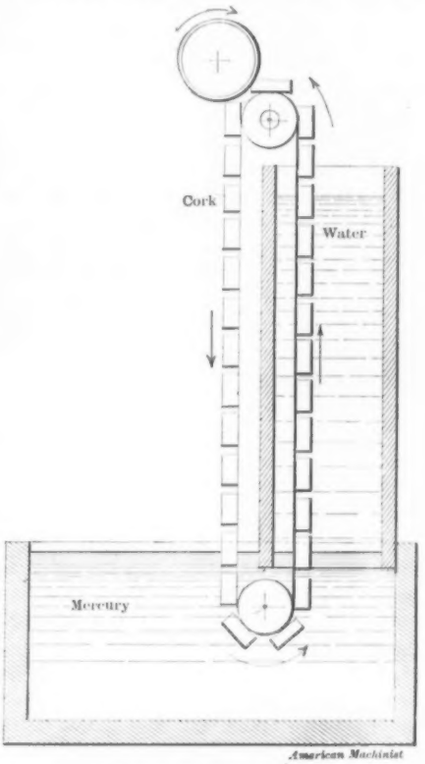
"'G. C. THORNELY.

"'Adswood Lodge, Stockport.

"'E. EAVES.

"'96 Chatham-st., Edgeley, Stockport.'"

At first sight it may look as tho the



AN ENGLISH PERPETUAL MOTION.

blocks of cork would be forced upward by the column of water on one side and that as they go through the corresponding space in air when descending the device will work. But as a matter of fact the level of the mercury under the column of water is necessarily lower than the surrounding mercury level by just enough to balance the pressure of the column of water and this means nothing else than balance the weight of the column of the "head" on the descending side is precisely equal to that on the ascending side and the device is readily seen to have no more tendency to drive itself than has any other perpetual motion device. If, as Messrs. Thornely and Eaves declare, a model made as shown by this drawing and including no other means for the application of power than is shown has been working for months, then all we can do is to cite our English friends to an old story which perhaps is new to some of them. A boy said, "I will give you a puzzle: That man is my father, but I am not his son. What is the answer?" The answer is, the boy lied.

Window glass is never permanently injured by water. Several shop superintendents have tried it; some apparently don't dare to.

Worm Gear Experience—Warnings and Examples.

BY J. E. JOHNSON, JR.

For several years past there has been a marked tendency to remove from the worm gear the ban which was long laid upon it, and to use it for speed reduction in power transmission, or even for increase of speed by driving the worm with the gear in some cases, instead of limiting its use to those places in which the self-locking ability of the screw was to be applied to a rotary motion instead of a longitudinal one, as with the ordinary screw and nut.

I would like to take this opportunity (late though it be) to make acknowledgment of the value of the articles on the worm gear and its efficiencies published at pages 24 and 46, Vol. 21, by Mr. F. A. Halsey, which have led to a distinct advance in the practical and theoretical knowledge of this subject and have probably been instrumental to a considerable degree in bringing about the increased use of these gears.

The gear shown in Fig. 1 was designed not long before the appearance of those articles, and would have been distinctly different had the order of their respective appearances been reversed. Warnings, however, are nearly always more effective in producing an impression than examples, and as this gear contains both, it is hoped its appearance here may be justified.

When this gear was designed I was aware that steep pitches were very much more efficient than flat ones, from some calculations previously made on the efficiency of screws of different pitches, and I went as far as I dared in the direction of steepening the pitch. Of course we know now that the diameter of the worm could have been reduced about two-thirds, or at least a half, keeping the pitch the same, with most beneficial results; but at that time I would not have dared to do it. About that time, or not very long before Mr. W. H. Booth had published in the AMERICAN MACHINIST some strong comments on the use of long teeth in gears, recommending that the length of tooth should not exceed six-tenths of the pitch, and under the influence of his logic the length of the teeth of this gear was made one-half the pitch, which accounts for their stubby look. Right here is where the first installment of the warning comes in, for teeth as short as this are not to be recommended for worm gears, for this reason: The length of the teeth does not affect the arc of contact of the teeth when unworn, because ordinarily one tooth will take all the thrust, and at the change from one tooth to another it is only divided between two, so that it is probably safe to say that the tooth carrying the pressure is never more than one tooth-space away from the line of centers, for in an unworn gear the normal to the worm-axis passes through the gear center. This being the case, and properly shaped teeth never bearing on their ends, but only on their faces, it is obvious that, as before stated, the length of unworn teeth does not affect the arc of contact; but it obviously *does* affect fundamentally the area of tooth face lying each side of the point of contact, especially at the beginning and end of the arc of contact, where the teeth have rolled on each other a good way toward their ends.

Now, when wear has taken place on the portion of the teeth in contact near the line of centers, the point of beginning or ending of contact is thrown farther and farther from the line of centers, and the area available on the teeth for withstanding the pressure is reduced thereby, until it is sufficient and rapid wear takes place at or near the ends of the teeth. This, in turn, lets the full pressure come upon the area just inside this, which similarly gives way until the obliquely worn corners of the teeth of the gear come more or less on top of the teeth of the worm, and almost a planing action results.

I do not know that I have made this very clear, but a worm like the one here shown when worn out shows its own history quite plainly, the central portion of the thread (lengthwise of the worm) being completely worn away and the remaining threads beveled off in such a way as to show that the action had been as I have tried to describe. If the teeth of worm gears were made of such length as would secure a good amount of bearing surface for any arc of actual contact that could exist with reasonable wear, I venture to believe that less wear, longer life and therefore higher efficiency would be secured. What this length will be will of course depend on the diameter of the worm gear in relation to the pitch for any given case and should be greater for a small gear diameter than for a large one. It is, however, only fair to the gear shown to say that it has run for five or six years without renewing the worm, the worm speed being fifty revolutions per minute and the load fairly heavy.

The materials and construction of this worm also gave some interesting and valuable information. Owing to the reputation of soft steel and iron for working well together, the first worm was turned from the solid out of mild steel at a very considerable expense in time and wages and the gears (two of which work in a single worm at an angle of 90 degrees from each other, 45 degrees each side the vertical center line) were cast by a gear-making concern not a thousand miles from Boston who give one the impression of standing firmly on their reputation and advertise machine-molded gears with any tooth section. The price paid for two gears was $30, as it was considered better to pay this than undergo the expense of making a pattern, especially as the patternmaker had never made a gear pattern of this kind, and would require a lot of coaching to get it right. When the machine-molded gears arrived they were recognizable by having the same number of teeth and about the same diameter as the gears ordered with a concave face; but not otherwise, as the tooth section was not much like the drawing and the face projection was so outrageously wrong that every tooth had to be chipped considerably on two diagonally opposite corners before it would mesh with the worm at all. However, the whole combination was gotten together at last and the machine for which these gears were the drive became, after some doctoring, a great success and was required to be in daily operation.

Within a few months of its starting, either the worm-bearing box with the semicircular pocket for oil, in which half the worm was supposed to run submerged, was allowed to get dry, or else some sand from a newly made sand pile blew into it (the machine works out of doors) and the result was that it became a thread-planing machine for planing threads off, and the worm was so badly damaged that it had to be turned end for end, being made double-ended for that purpose. It ran on for several months longer, but then became so badly worn that its successor had to be provided, and having a distinct recollection of the work of turning the first one, a pattern was worked out by hand from which a worm was cast, which was bored out and the ends turned to the proper shape and was the identical worm removed, worn out, at the end of five or six years, as above mentioned.

As this gear worked under precisely the same conditions as the second side of the steel worm (which was untouched when put to work with the gears entirely encased) this seems to indicate that gray iron is not to be despised as a material from which to make worms, even in comparison with machinery steel. Subsequently the original gears wore out also, and during my absence the tracing from which the engraving shown herewith was made was turned over to the patternmaker, who for something rather less than $15 in wages and materials turned out a gear pattern which was almost perfect and gears from which were as far ahead of the machine-molded ones as day is ahead of night. It will be seen that the tooth sections are almost entirely devoid of dimensions, as it was intended to have the teeth made from a series of templets, if it ever came to be done, and the exact method pursued by that patternmaker to produce the excellent result he did in what was (for him) a very reasonable time has always been a mystery.

The problem of shaping these teeth correctly is by no means a simple one, and I hope to give one solution which has given satisfactory results, in a later article. It will be noticed that the ends of the worm are turned to a peculiar concave curve, and it was really this curve and its action as a thrust bearing that inspired the present

article in the first place. It is well known that foot-step or thrust bearings are always a prolific source of trouble, and this is probably one of the reasons why worm gearing had such a hard fight to get a foothold in mechanical life. The reasons that bearings of this class wherever used, from the propeller shaft of a steamer to the step of a vertical shaft in a factory building, give trouble are not far to seek and are two in number:

First—Such bearings are continuously under pressure over their entire surface, so that there is no "point of no pressure," or even of partial vacuum, at which the oil will be drawn in, as in a revolving bearing, but it always tends to be forced out, and lubrication is consequently very difficult.

Second—The wear of any bearing is proportional to the product of pressure and velocity of rubbing surfaces, other things being equal, and in a *flat* step-bearing the pressure is of course uniformly distributed over the whole surface, but the velocity is greater as the distance from the center increases. Consequently the bearing wears much faster at the outside edges than in the center, and its *effective* area is practically reduced by wear, throwing increased pressure on the remaining portion and further increasing the tendency of the outer portion of the remaining effective surface to wear. The whole bearing is thus rapidly worn away in detail, as it were.

It first occurred to a man named Schiele, now a good many years ago, that if the pressure on successive narrow rings of the whole area were increased as the distance toward the center diminished, the product of pressure and velocity, and therefore the wear, would be uniform over the whole bearing, the wearing away in detail could no longer take place and the bearing would last indefinitely longer.

This is the theory, and it is fully borne out in practice, at least in the present in-

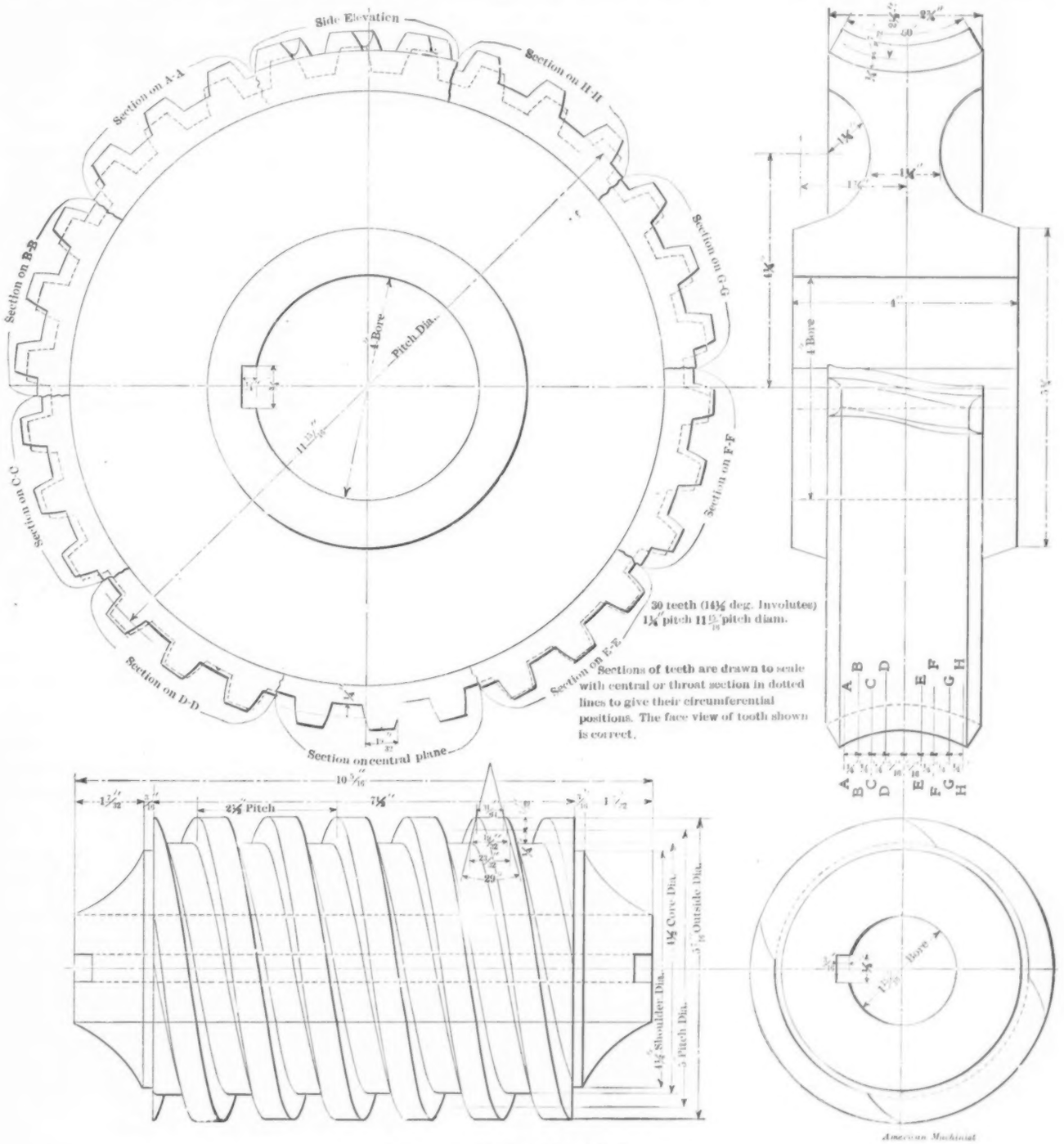


FIG. 1. A SHORT TOOTH WORM GEAR.

stance. The worm bearing in this case was made both a shaft-bearing and a thrust-bearing at each end of the oil pocket, which constitutes the main body of the casting. The split bearings were babbitted in place on the worm, and these bearings have never been touched during nearly seven years of continuous service; while as to the worm, the one worn out in service showed no sign of more than very slight wear on the ends, the templet to which they were turned up originally fitted them about as well when worn out as it had at first, and there were no signs of scoring or grooving. Considering the simplicity and cheapness of this bearing as compared with many others adopted, and the satisfaction it has given in service as contrasted with the trouble frequently experienced with this detail, I venture to hope that this reference to a device which is many years old and described in several works on mechanics, but which has never received the attention its merits seem to warrant, is justified. Schiele's curve is the same as the tractrix, and the method of laying it out is given in various works, but for the convenience of those who may be interested is given here, together with an approximate method that may be new to many:

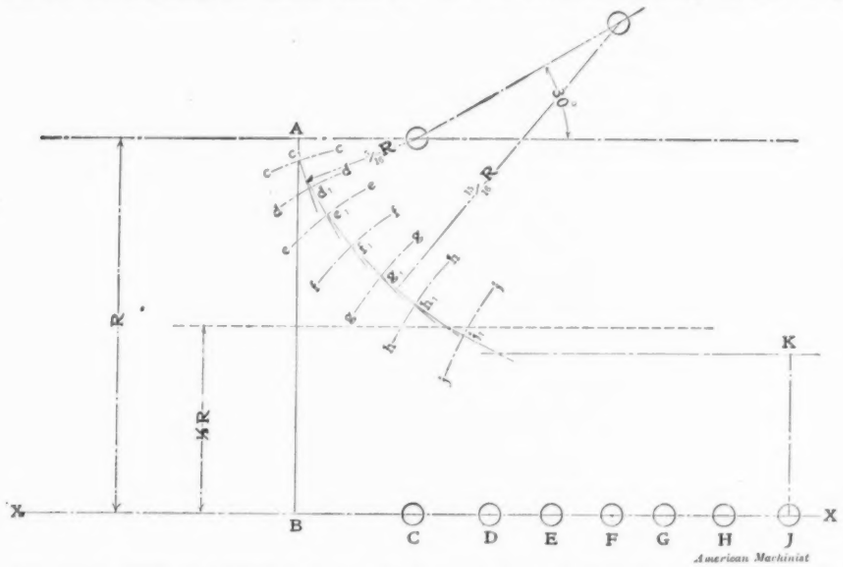


FIG. 2. METHOD OF LAYING OUT SCHIELE'S CURVE WITH CIRCULAR ARCS GIVING CLOSE APPROXIMATION.

X X, Fig. 2, is the center line of the shaft, *A B* the maximum radius of the thrust bearing, and *A* the point of beginning of the curve. With *A B* as a radius from any point *C* a short distance from *B* on the axis, strike a short arc *c c*, intersecting *A B* at *c*. Draw the line *c*, *C* or a small part of it next *c*, and from point *D* with the same radius proceed similarly, obtaining the line *d*, *D* and successively with points *E F G*, etc., until the outer portion of last line drawn comes down to the minimum radius desired for the bearing or to the radius of the shaft passing through the thrust bearing. In practice there is little to be gained by making *J K* less than half of *A B*. A smooth curve tangent to all the short lines outside their intersecting arcs is readily drawn and is the curve desired. The whole operation can be done in less time than it takes to describe it, so let no one be scared from its use by the description of its generation.

For all practical purposes the curve may be drawn as two arcs of circles, as shown in the sketch, first an arc struck from the outside line of the bearing, prolonged, with a radius of 5-16 *R*, then tangent to this a second arc of radius 15-16 *R*, with its center on a line diverging from the outer line of the bearing at 30 degrees passing through the center of the first arc.

The theory and practice of this matter are a confirmation of Professor Sweet's theory that "*surfaces which do not tend to wear out of truth do not wear much,*" which would seem to have as a corrolary the fact that wear which takes place in detail—that is, by subjecting a small portion of the whole bearing surface to the whole pressure to be resisted or a large part of it, and almost *crushing* it away, leaving the next small portion of the area to be treated the same way in turn, is much more serious than wear which results when two similar surfaces bear fairly upon each other under the same pressure. These are matters which seem very simple at first sight, but the more they are given consideration the more evident it becomes that they deserve it.

When the iron business took on a boom some time ago every man who could get possession of a worn-out iron furnace at once went into the business for all he was worth, without much thought of the morrow. The out-of-date flour mills which are now being resurrected will have a better fate. The purchase of a steel rail can be put off for a time, but a man's stomach submits to no delay.—*American Miller.*

Setting Boiler Tubes

Various methods have been devised and various tools employed for setting tubes steam- and water-tight in boilers and condensers. Probably the earliest tool used was a round, tapered plug 1, small enough on the point to enter a short distance into the end of the tube, the plug being driven in with maul or hammer. This was found to be inefficient, for the reason that the plug was taper while the hole in the tube-sheet was straight, making the tube tight only on the outer edge of the hole. It was also liable to split the end of the tube on account of the excessive bearing surface.

An improvement on the tapered plug is the tool 2. This, a three-ribbed mandrel, presents less bearing and more gradually opens the end of the tube, its position being changed at each blow of the hammer. This also has the fault of being taper; to use these tools to good advantage the holes in the tube sheets should have a corresponding taper.

The Prosser tube expander 3 was among the earliest designed to tighten tubes by expanding uniformly, and making a straight fit in straight tube sheet holes. It is a sectional tool, its parts being held together by a spring ring *b*. When assembled these form a body with a tapered bore. A taper mandrel is provided, which, when driven in, distends the sections, increasing the diameter of the tool. With this tool the extending end of the tube is made bell-mouthed; the tool also forms an inside bead in the tube against the inner edge of the tube sheet while it expands the tube in the tube sheet hole.

The Dudgeon roller expander 4 was the next to appear, and is still very extensively used. This tool, as its name implies, enlarges the tube by a rolling process. Three steel rollers are held in seats in a body, and are revolved and forced outward by a slightly tapered mandrel. A later design of the Dudgeon 5 has the seats for two of the three rollers set at an angle with the axis of the tool, which acts as a feed to draw in the mandrel instead of driving it in, as is necessary in the older style. The roller expander is a good, serviceable and efficient tool in the hands of careful workmen who know when to stop rolling, for with it a tube can be rolled to a dangerous thinness, at the same time stretching the tube sheet and springing it out of shape.

The Dudgeon operated by hand uses the mandrel as at 4, and operated by pneumatic machine uses the mandrel as at 5.

The next tool to mention is the Deane tube expander 6. It consists of a cylindrical body having cut in it obliquely a groove which holds a small gib *a*, that is forced outward by a wedge *b*. The working face of the gib resembles in outline a section of the "Prosser" and is for the same purpose—*i. e.*, expanding the tube and raising an inside bead. In action the whole tool is rotated while being driven. This has been used successfully, but is slow in operation, and the wear on the gib

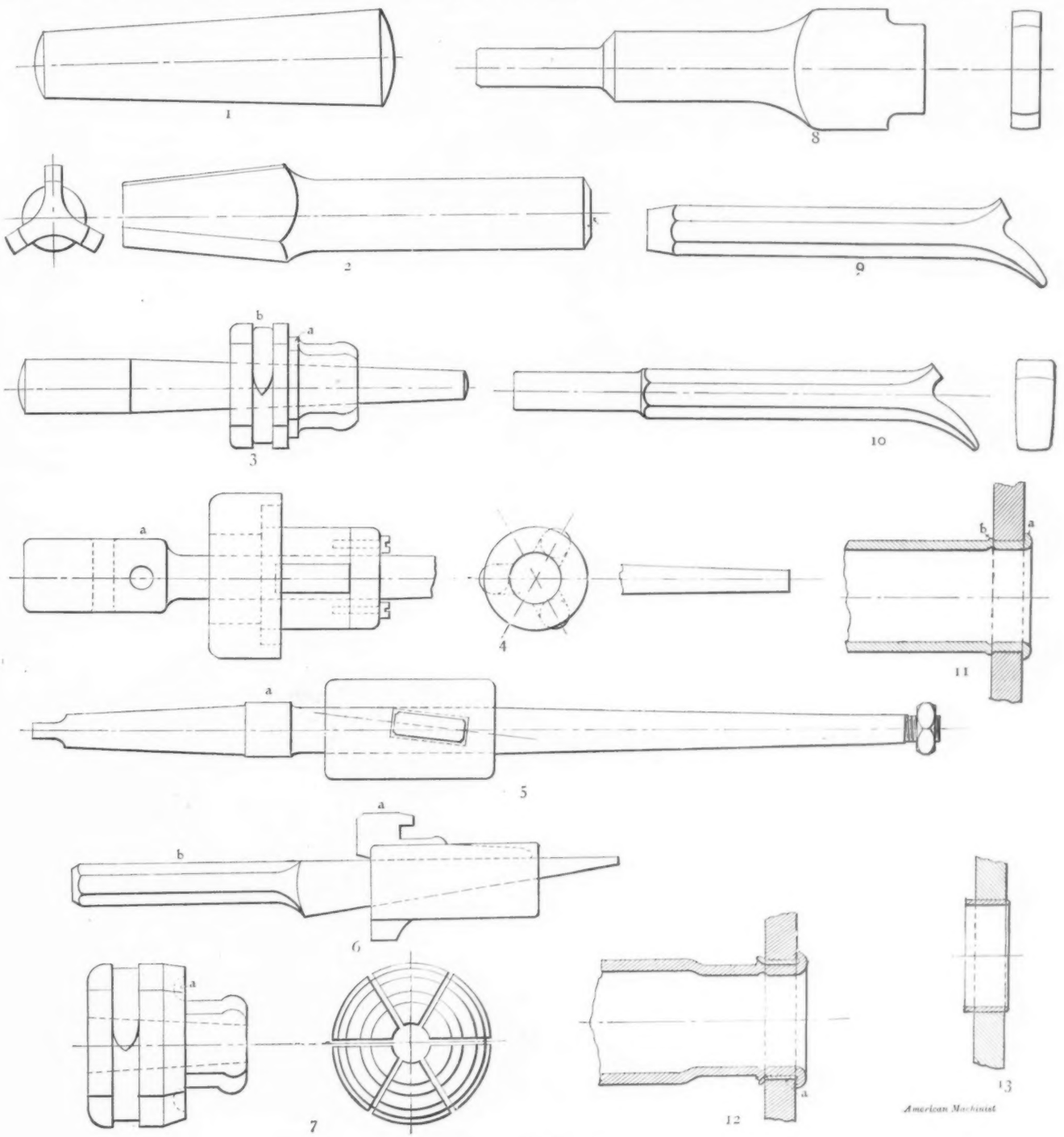
excessive. It is also a dangerous tool in unskilled hands, for if driven in the full amount in one place it is liable to split the tube.

An improvement on the Prosser is made by the Pratt & Whitney Company, 7, used with a taper mandrel, not shown. This, it will be noticed, has an encircling, over-hanging flange which bears against the tube sheet, acting as a gage to properly locate the beading end of the tool, and so bringing the bead against the inside edge of the tube-sheet. The inner shoulder used on the original Prosser 3*a* for turning over the extending end of the tube is cut away, leaving a strong fillet 7*a*.

The latter-day method of tube end finishing proceeds as follows: The tube is first located in the tube sheet, allowing 3-16 to ¼ inch to protrude. Then with a Dudgeon roller tool the tube is rolled to a tight fit, after which the tool 8 is used to turn over and round up the end. This last is really a caulking operation, and is finished best with the tool 9 held in the hand and struck with a hammer, or the one 10 used in a pneumatic hammer. On account of the metal being cold, this boot-shaped tool is best used, as it is necessary to very gradually draw the end of the tube down and around to make a smooth, tight job. This rounded end is shown at 11*a*. After rounding the end, the improved sectional tool 7 is inserted and the inside bead 9*a* is made, and at the same time the tube is still further tightened in the tube sheet.

As the tube has been turned over on the end by the boot tool, the shoulder 3*a* on the old-style Prosser is dispensed with and the stiffening fillet 7*a* is formed, which clears the finished end of the tube, otherwise it would be marred by its sharp corner. After the inside bead is made the tube should again be rolled with the "Dudgeon" for a final finish.

This method insures a good, tight job both sides of the sheet, and inside the



TOOLS FOR SETTING BOILER TUBES.

hole in the sheet. It does not damage the tube in the least and the work can be done rapidly, as the tools are all very simple in construction and are easily and quickly operated.

The following applies more particularly to the firebox ends of tubes. Various styles of flue ends are made, depending generally on the water of the locality where the boilers are to be worked. The style most used for the firebox end is with this end of the tube swedged down 1/8 inch less in diameter, and a copper ferrule soldered on 12; or, better, the ferrule 13 may first be rolled in the tube sheet hole and the tube end then inserted and rolled. When finished the copper lies between the tube and the sheet all the way round, as at 12*a*, the purpose being to prevent corrosion.

The smokebox end is very often merely rolled and not turned over on the end, and seldom has an inside bead, tho any combinations for the ends are used. Another style is with both ends plain 11 where tube and sheet are metal to metal.

In locomotive practice it is necessary to put the tubes in from the front or smokebox end, and the front holes are made 1-32 inch larger than the nominal diameter of the tube to allow them to pass through freely. At the firebox end, being the more particular end of the tube, the hole in the firebox tube sheet is made 1-64 inch less than the nominal diameter of the tube, and this end of the tube is made 5-1000 inch full of this size, which makes a good, snug driving fit.

Since the advent of pneumatic tools for this service the work has been very much facilitated and the life of the tools prolonged. H. E. B.

A Large Power Silent Chain Drive.

The accompanying photographs show a 500 horse-power Renold silent chain drive which has been recently installed by the Link Belt Engineering Company at the Arlington Mills, of Lawrence, Mass.

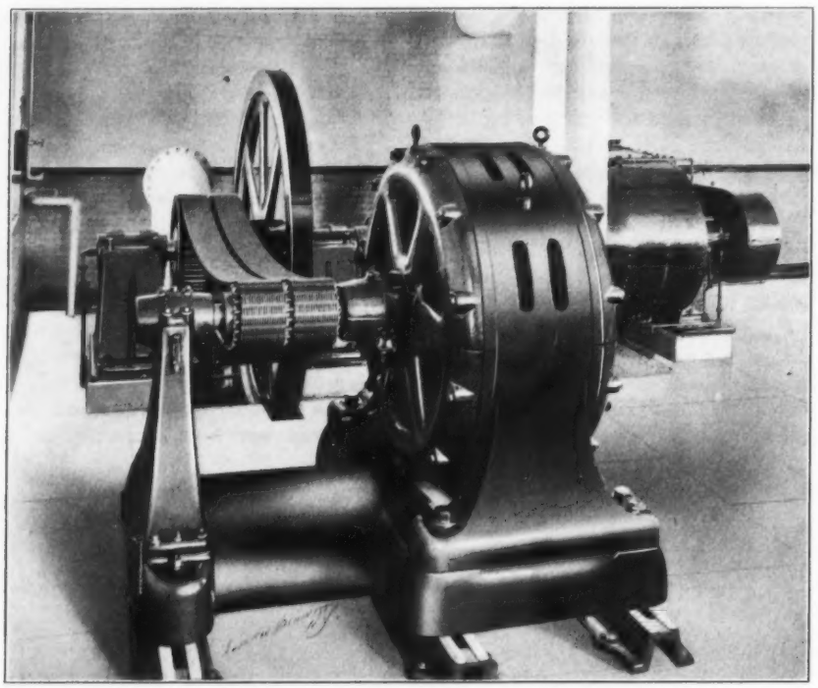


FIG. 1. LARGE POWER SILENT CHAIN DRIVE.

The object of the installation is the driving of a Roots blower for forcing vaporized naphtha through raw wool in order to clean it of grease. The power is supplied by a General Electric induction motor, of which the speed is 480, while that of the blower is 166 revolutions per minute. The distance between shaft centers is 11 feet 3 inches, and the drive consists of one 12.15 inches diameter, 21-inch face, 19-tooth motor sprocket; two 35 inches diameter, 10½-inch face, 35-tooth flanged blower sprockets; two strands of 2-inch pitch, 9 inches wide Renold silent chain.

An interesting feature of the drive is the provision of spring centers for the blower sprockets, as shown in Fig. 2. The object of this construction is to absorb irregularities in the load on the blower shaft and correct variations in angular velocity, thus protecting the chain from shock. Each of the blower sprockets has its own spring center, the result of which is to equalize the strain on the two chains and thus insure that each does its share of the work.

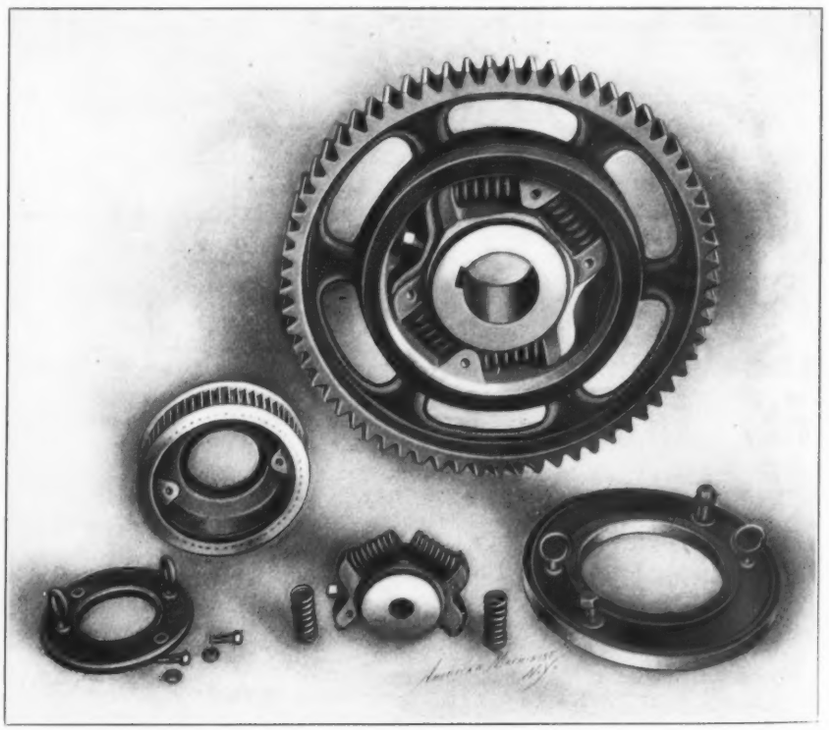


FIG. 2. SPRING CENTER OF BLOWER SPROCKET.

Forming.*

The forming of circular machine parts of diameters up to 6 inches in most cases is a great saving over turning with a single-pointed tool.

As a demonstration, suppose for convenience we reduce 7 inches of a 3 1-7 bar to 2 1-7 inches. At 1-100 inch feed per revolution this reduction can be made in 100 revolutions at 75 feet, or in 1⅓ minutes.

With a single-pointed tool we could cut at 200 revolutions at 80 feed at the best, to finish a reasonably smooth surface, consuming 2⅔ minutes, and showing a gain by forming of over 100 per cent., where in 12 inches the gain is nearly 300 per cent.

*Abstract of a paper read before the Cincinnati Metal Trades Association by an employee of the Lodge & Shipley Machine Tool Company.

This is only on a plain, straight job, to say nothing of time saved on irregular surfaces and angles where the time required for forming is probably less, at least not more, and the time for turning increasing with complication of the job.

The curling of a chip 8 inches wide by 5-1000 thick from a piece of work is a very good demonstration of the advantages of forming.

Contrary to the generation of heat at one point, the main difficulty in high-speed single-tool cutting, the heat in the case of the forming tool is distributed the full length of the tool at a very slow rate and is easily removed by a flood of soap water, generally used for steel cutting.

Machine parts may be formed, bored and cut off the solid bar in from one-fourth to one-eighth the time required to bore and form or turn castings that are cored and nearly the correct shape and size.

Besides the fact that the work requiring the most skill and care in measuring and machining such parts as single and double bevel gears and long curves and irregular shapes is done away with, the product is made interchangeable and may be machined by a cheap man at a rapid rate.

The principal difficulties to contend with are the tendency of a wide-nosed tool to follow an untrue surface, belt slippage and the tendency of the tool to press the work off center.

The essentials for this work are a rigid lathe in general, massive journal, heavy cross slide and an easily manipulated rigid steady-rest, the forming to be done between journal and steady-rest.

I find a two-jawed rest operated by a vertical right- and left-hand screw very convenient. A substantial draw chuck will hold cold rolled steel true enough and tight enough for the heaviest forming.

Cold rolled steel is used for forming most machine parts to take the place of castings, as it is soft, has no scale and no irregularities, and the finished parts far excel gray iron for b"shes and pinions.

The principal difficulty in forming is the wearing of sharp corners off forming tools, requiring the grinding of the whole top surface of the tool that it may retain its shape.

The most economical way of making such tools is to set in the shaper with clearance blocks and plane clearance on all parts except sides of straight cutting parts, which are to have no vertical clearance, but 1 or 2 degrees back or away from the cut. Tools may be made of any convenient length in this manner and clamped to the rest by a dovetail at the back.

Tools made in this way may be ground on top without impairing the shape in the least.

General purpose tools are set at or slightly above the center with from 3 to 5 degrees front rake and little or no top rake.

A shearing cutter does very well on light forming of gray iron; less strain is put on the work and machine, and the cutter has less tendency to ride on the work than in the case of a straight cutter, the cutting being done on a narrow surface traversing from one end to the other.

The operations on regular parts are as follows: Form No. 1 to proper diameter, run No. 1 in steady-rest and bore while forming No. 2, run No. 2 in rest, cut off No. 1 and bore No. 2 while forming No. 3, and so on. Where no rest is needed the piece may be bored and formed at the same time, doubling the efficiency of man and machine in both cases.

Holes are bored in this machine by starting with a rigid starter, following with a revolving soap water drill and reaming with a rose reamer—no truing bar being necessary.

Apron bushings 2½ inches in diameter, 3 inches long and 1 11-16 bore are formed, threaded, bored and reamed and cut off at the rate of five minutes each.

The 7-inch hub of a 2 5-6 gear can be formed from a 2⅞ bar to 1 13-16, bored 1 5-16 and cut off in less time than the casting can be turned after being bored and faced on the large end.

In forming long light work the pressure of the tool forces the work off the center in the middle, making the work large in the center. This may be avoided by setting another cutter or a rest in the rear and feeding both to the center by a right- and left-hand screw, the cutters centering themselves by equalizing the strain on each other. The objection to using two cutters is that the rear cutter has no substantial backing, and has a tendency to lift.

It is my opinion that a suitable rest could be made with the two slides drawing toward the center, in this manner relieving the spindle and steady-rest of nearly all the strain, or possibly working without the steady-rest.

For economy in forming a great variety of studs, stems or any small parallel work a gang forming tool may be used, composed of a number of blades of different widths set side by side and adjusted to different diameters by closely set screws in the block behind them. In this case a stock consisting of a variety of these tools is necessary to accommodate different lengths and diameters.

The automatic forming rest should be equipped with a wedge with set-screws back of it for vertical adjustment, and set-screws back of the cutter to set it parallel and adjust for small change in diameter, a difficult matter on the old-style automatic.

We have in use length-forming tools for all stems and screws, to relieve the operator of close measuring operations, assuring proper length of rounding to match the nut and practically answering for a standard.

Drop forgings may be formed from the scale at 80 feet, and scaled castings at 60 feet. In facing bevel gears and the like, a close-fitting pilot in the box tool receives part of the strain of the cutter and follows the hole in case it is not bored dead true. The advantage of dishing out face gears with a forming tool after scaling can be appreciated at first sight.

It is not the high speed and feed, but the steady cutting that accomplishes the best results with the forming tool; no delay in measuring, calipering or shaping. It is simply a case of feed the cutter in until the diameter is reached in one place, and you have the proper diameter and shape over the whole piece. The efficiency of a machine and careful man under these conditions can well be appreciated.

Construction of the West Point Chain.

BY E. P. BUFFET.

Confusion may easily exist between the different chains that were stretched across the Hudson river by the American army at one time or another during the Revolutionary War. Of such chains as many as three are recorded, besides at least two booms and a *chevaux-de-frise*. One of them, with a boom and *chevaux-de-frise*, was completed at Fort Montgomery, opposite Anthony's Nose, in 1777, but failed to prevent the passage up the river of a British expedition which resulted in the burning of Kingston. Contemporary documents prove that there had been a difference of opinion whether to place this chain at Fort Montgomery or West Point.

The chain that was afterward installed at the latter place, reaching to Constitution island, was wrought in the early part of 1778. According to Lossing's version of its history, it was 450 yards long, made of equal parts Sterling and Long mine ores by Peter Townsend, of Chester. The general superintendent of the work, as engineer, he says, was Capt. Thomas Machin, who, accompanying Col. Timothy Pickering, arrived at Mr. Townsend's house one night in March (*sic*) to engage him to make the chain. They set out at once in the darkness amid a violent snowstorm for the Sterling works, and next morning the forges were in operation. Lossing takes the view that it was completed in six weeks—by about the middle of April—and stretched across the river May 1 (really April 30) buoyed on sharpened 16-foot logs (which the weight of evidence shows to have been a permanent feature) and steadied by occasional anchors. From various authorities we learn that it was cramped into the rocks or attached to blocks at either end. If a vessel should attempt to break it, the chain, moving on a roller, would grow slack, and when strained again to due tension would turn the ship's bow to land. It was made in sections of some 10 or 12 links, connected by clevises, each link weighing 100 to 150 pounds, as diversely stated, and the entire chain 180 or 186 tons. Connecticut teamsters, it is said, came with their oxen to cart it. Sidelights from contemporary documents ren-

der it quite likely that New Englanders were indeed brought over the border for this purpose, and also indicate that they may have been impressed. One oral authority has the impression that the chain was transported on mule back. In the Sterling region I have heard of a man whose grandfather helped to haul the chain and another whose grandfather aided in making it. History tells us that the chain was transported to the Point *via* New Windsor.

An inquiry on just what part of the Sterling properties as they stand to-day the chain was actually made is like asking 125 years hence whether a particular contract of the Carnegie Company was executed at Homestead, Duquesne or Braddock. Still, it is not without interest. According to one theory the iron was melted in the furnace shown in Figs. 3 and 4 of my first article on the Ramapo region; according to another, at the legendary "Black Meadow" furnace therein referred to. There is some traditional testimony in the vicinity that it was hammered out in part at the forge within the field of Fig. 8 (same article) and in part at a forge on the Ramapo river which seems to be confused with the Augusta works. Undoubtedly all the Sterling plants existing at that time were kept busy on the contract and not improbably some of it was sublet to neighboring furnaces or forges. There is an opinion in some quarters that part of the chain, at least, was forged at the Long Pond or Ringwood works. This rests, so far as I have heard, partly on alleged tradition and partly upon the presumption that, since the chain was too great a piece of work to be turned out by one company in so short a time and the other plants named were only a few miles from Sterling, part of the contract would naturally be filled by them. This view is said to have been shared by the late ex-Mayor Abram S. Hewitt with whose interests these other furnace sites have in modern times been identified. Possibly their participation, if any, was in making the Fort Montgomery chain. The George Clinton papers prove that Robert Erskine, proprietor or manager of the Ringwood works, made shoes for a *chevaux-de-frise* in 1777, doubtless the same that was associated with the Fort Montgomery chain. That the main contract for the West Point chain was given to the owners of the Sterling works is proved beyond a reasonable doubt by the documentary evidence I am about to present.

One of the accompanying cuts (Fig. 1) is copied from Lossing's "Pictorial Field Book of the Revolution," and shows a specimen of the West Point chain which he found preserved there. Some years ago about 100 feet of what is regarded as one of the Hudson River chains were sold for junk at the Brooklyn Navy Yard and were secured by Mr. Hewitt, who brought it to his estate at Ringwood. There is another chain fragment at Glen Island, N. Y. In the historical collection at Newburg, N. Y., is a link of the Fort Montgomery chain taken from the bottom of the river in 1861. At the same place is a part of the West Point boom (see Fig. 2), fished up from the river bottom in 1856. It is cataloged as "composed of massive links secured by bands to the logs by which they were floated. The boom was placed on the south side of the chain and was the most formidable obstruction of the two." We may assume that this boom was distinct from the log buoys on which the chain was floated, and that the links at the end of the boom-logs shown in the cut were not a part of the big chain.

Corresponding Secretary William Nelson, of the New Jersey Historical Society, writes as follows: "Mr. F. A. Canfield, of Dover, a well-known mining expert, informs me that when the United States Government sold at the Brooklyn Navy Yard, some years ago, the portion of an old chain, it was bought by a junk dealer, bearing the famous and highly distinguished name of Westminster Abbey. Mr. Canfield examined some of the links at the time, and found them to be 3 or 4 feet long, of 5-inch iron, handsomely forged,

FIG. 1. FRAGMENT OF A CHAIN AT WEST POINT.

with swivels and rings, and altogether of a style of workmanship far superior to anything known to date back to 1776. The history of these links could be traced at the Brooklyn Navy Yard about sixty years, but no further."

To the foregoing account may be added certain very important documents relating to the West Point chain, including the terms of contract and specifications for it, found among the papers of Governor Geo. Clinton, of New York, which are now being published volume after volume. I am not aware that these authentic records have ever before been connected with a narrative of the chain.

The following letter explains itself:

"Fishkill 3rd Feb'y 1778
"Tuesday Even'g."

"Sir, I have the Honour to inclose your Excellency a Copy of the agreement enter'd into with the owners of the Sterling Iron-works, and wish that it was better, on the Part of the States. Haux was got Home which encreased the Difficulty. However, I did the best I could, and hope that it will meet with your Excellency's Candour as well as that of the Legislature, in general.

"They want 8 or 10 Hands to blow and strike till they can call in others to supply their Places. But mean to pay for their Labour. In the Morn'g I shall apply to the General for them.

"The first exemption was given them, which I transcribed and inclose a Copy; recollecting that there was no Transcript kept by your Execllency. There was no such Thing as concluding the agreement without exempting their Teams for the same Time. Nay, they had the assurance to demand Exemption for all they should hire, which I positively refus'd, telling them that they might enable them to sell Exemptions, by giving Certificates that Teams were in their Service, when otherwise, which they affected to resent.

"They are in want of two Pr. Bellows, which will go on to-morrow from here. . .

"HUGH HUGHES.

"P. S.—I wrote to Mr. Thomas Lawrence, near Dobb's Ferry, and late of N. York, a most excellent workman, to superintend the Chain and Anchors whilst making and hope will accept. H. H.

"His excellency Governor Clinton."

"ARTICLES OF AGREEMENT between Noble, Townsend & Company, Proprietors of the Sterling Iron Works, in the State of New York, of the one part, and Hugh Hughes, D. Q. M. G. to the Army of the United States of the other Part Witnesseth.

"That the said Noble, Townsend & Company jointly and Severally engage to have made and ready to be deliver'd, at their Works, to the said Hugh Hughes D. Q. M. G. or to the D. Q. M. G. of the Middle Department for the Time being on or before the first day of April, next ensuing the Date hereof, or as much sooner as Circumstances will admit, an Iron Chain of the following Dimensions, and Quality, that is, in Length five Hundred Yards,—each Link about two feet long, to be made of the best Sterling Iron, two Inches and one Quarter square, or as near thereto as possible, with a swivel to every hundred feet, and a Clevis to every Thousand W't in the same manner as those of the former Chain.

"The said Noble, Townsend & Comp'y also Engage to have made, and ready, to be deliver'd at least twelve Tons of Anchors of the afores'd Iron, and of such Sizes, as the said Hugh Hughes or his Successors, in Office, shall direct, in writing, as soon as the Completion of the chain will permit. In Consideration of which the said Hugh Hughes D. Q. M. G. in behalf of the United States, engages to Pay to the said Noble, Townsend & Company, or their order, at the rate of Four hundred & Forty Pounds for every Ton Weight of Chain & anchors delivered as before ment'd; unless the General Regulations on Trade, Provisions, &c. which are now Supposed to be framing by Deputies from the United States shall be Publish'd and take Effect before the Expiration of Four months from the Date of this, In which Case the Price to be only Four Hundred Pounds P Ton for the said

Chain & anchors.* The Payments, if Demanded, to be made in such Proportion, as the Work shall be ready to be delivered which shall be determin'd in ten days after requisition made, by a number of Competent Judges, not less than three, nor more than five, unconnected with the Proprietors or the Works, and if Condemn'd, to be Compleated at the Expence of the said Company, who are also to repair as aforesaid, all Failures, of their Work, where ever happening, whether at the Works, or River, or in extending it across.

"The said Hugh Hughes also engages to procure, of the Governour of this state, for the said Noble, Townsend & Comp'y an Exemption for nine months from the Date hereof, from Military Duty, For Sixty Artificers, that are steadily to be Employ'd at the said Chain and Anchors till Compleated, agreeable to the said Exemption the said Company complying with the Terms thereof, providing also that the said Comp'y give the said Hugh Hughes, or his successors in office the refusal, by Letter, of all the Bar Iron, Anchors, &c. made at the said Works in the said Term of nine months at the Current Price, unless what is necessary to Exchange for Cloathing and other articles for the use of the works.

"It is also agreed, by the said Parties, that if the Teams of the said Company shall Transport the said Chain or anchors, or any part of them, to any assign'd Post, they shall receive for such Services the same Pay as shall be given by the United States for the like. The Teams of said Company being Exempted from Impress by any of the Q. M. General's Depart's during the space of nine months from the Date hereof.

"Lastly, the said Comp'y engage to use their utmost Endeavours to keep Seven Fires, at Forgeing, and ten at Welding, if assisted with such Hands as are necessary & can be spared from the army, in Case of their not being able to procure otherwise, the said Comp'y making deduction for their Labour.

"In Witness whereof the Parties have Interchangeably Subscribed their Names this second of February One Thousand, Seven Hundred & Seventy Eight, and in the second year of American Independency.

"Peter Townsend & in behalf of Noble & Comp'y.

"Present O. Tillinghast.

"Copy."

In connection with the above is a copy of an agreement by Gov. Clinton that sixty persons shall be exempted from military duty (unless in cases where the whole militia of the county are called out) if steadily at work on the chain.

General Samuel H. Parsons wrote Clinton February [24] 1778: "I intend tomorrow to visit ye Iron works & find ye situation of the chain."

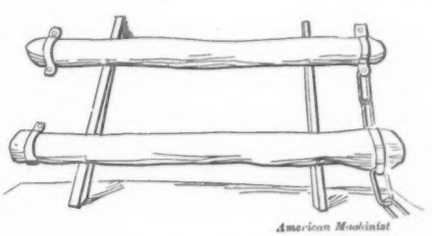


FIG. 2. PORTION OF THE BOOM, WEST POINT.

A little later Hugh Hughes wrote Gov. Clinton as follows:

"The Villiage 11th March 1778.

"Sir, The Letters for his Excellency, General Washington, as well as those for the Eastward, were forwarded immediately, by Express. It seems to be the General's [what general's?] opinion, as well as Col. Malcom's, that the chain ought not to be mov'd till the works are in some measure defensible. I shall therefore decline their Removal till I have the Honour of wait'g on Your Excellency again.

"I intend availing myself of the Teams that carry the Salt Provision to Morristown, and have them loaded back with Shot &c. from Ogden's and Hoff's Works.

"Mr. Faish [Faesch] tells me that he has given 50£ P Ton for the Transportation of Iron to the River, which is a most astonishing price. . ."

Finally Gov. Clinton stated in a letter to Gov. Trumbull, of Connecticut, May 1, 1778: "The Chain which exceeds the old one in Point of Strength was drawn a Cross the River at West Point on the 30th of last Month."

The West Point chain proved final, and with its attendant fortifications, kept the river closed through the war. Lossing says that Arnold while plotting to deliver up West Point wrote André that in order to weaken the obstructions he had ordered a link to be removed and sent to the smith for repair. Another, and perhaps a more trustworthy, version of this story relates it to the chain at Fort Montgomery.

*From time to time during the war, conventions of delegates from groups of States met to recommend legislation for the regulation of general prices on grain, manufactured goods, labor, transportation, etc. This today seems a flagrant invasion of private rights, but circumstances were believed to necessitate it. The machinations of engrossers, forestallers, speculators, monopolizers, etc., closely related to the inflation of the currency, sometimes rendered military supplies so hard to obtain as almost to force disbandment of the army.

In 1765-6 the value of bar iron exported from the port of New York had been £26 sterling per ton, and of pig, £7 10s. About 1775 or 1776, it was £17 (sterling?) for bar and 75s. for pig. The usual price of bar in ante-bellum days is estimated at $64 a ton, referring, perhaps, to Spanish dollars. Before the close of the war the price of pig had been quoted at least as high as £300 per ton, in Continental currency.

The New Haven convention which met about the end of January, 1778, recommended that the States represented in it enact laws fixing the following maximum prices, among others, "to be estimated in lawful money at six shillings pr. dollar": Bloomery iron at place of manufacture, £48 per ton; refined do., £56; pig do., £18; best American manufactured steel, fit for edge tools, 2s. per lb.; common steel manufactured in America, 1s. 4d. per lb. Teaming and other land transportation was not to be above five-twelfths of a Continental dollar for the carriage of 20 hundredweight per mile, including all expenses. Without entering into the question whether any price-regulating law that may have been in force in New York at the time of the Sterling contract was binding on the government, it could hardly in any event have been conclusive as to the minimum rate, nor would a subsequent change naturally have affected agreements already made. Perhaps the Sterling people used the statutory quotations as an *argumentum ad hominum* in their favor. The price named in the contract would turn our modern armor plate manufacturers green with envy were they not reminded of the allowance that should presumably be made for the inflated condition of the currency.

Legal Notes.

BY E. P. BUFFET, LL. B.

SPEEDING UP EMERY WHEEL.

In the case of Skelton *et al.* vs. Pacific Lumber Company, action was brought by a widow and minor children to recover damages for the death of a workman by the bursting of an emery wheel in a machine shop of the defendant. From the statement of facts the following, altho disputed, seem to have formed the basis of the decision. The general superintendent and manager of the corporation, who had authority over the speeds at which the machinery should be run, was directing the testing of a new shake machine to see if the power was sufficient and the machine safe. This was done without disconnecting the other machines in the shop from the power, and as they speeded up the emery wheel burst and killed Skelton. The Supreme Court of California has affirmed judgment awarding damages for his death, and in so doing calls attention to the well-settled law fixing upon a principal the liability for the negligence of an agent to whom he delegates the performance of a duty resting upon himself. The court implies that if the engineer had heedlessly permitted an excessive rate of speed the act might have been that of a co-employee and the company not liable, unless it had been negligent in selecting him. But as the engineer was acting under the superintendent's orders it was different. It is not the grade of the service, the dignity of the office, but the character of the act, which determines a vice-principal, and the superintendent's authority to fix speeds and to test the shake machine counted for more than his title.

The court further holds that if the breaking of the wheel was caused by the catching of the tool deceased was grinding, between the rest and the wheel, this alone would not entitle the defendant to a verdict, since the catching might have been due to the excessive speed, without negligence on the part of Skelton.

In this case a verdict of $18,000 damages was allowed to stand, the court remarking, "As compensation to a widow and six minor children, we are not prepared to say it was excessive." 74 Pac. Rep., 13.

Inquiry for Catalogs.

Charles A. Francis, Instructor of Mechanical Department, Tokyo Higher Technological School, Tokyo, Japan, would like American machine tool builders to send him copies of their catalogs, of which he is making a collection.

Proportioning Machine Parts.

BY HENRY HESS.

It is a safe assertion to make that the dimensions of detail parts of machines in general are fixed more or less by rule of thumb rather than by any careful analysis of the strains that the parts are to withstand. That naturally brings about great divergence in the proportions of quite similar elements not only in the practise of different shops engaged in similar lines, but even in the relative proportions of a series of machines built in the same shop.

Were an entire series of some machine designed at one time by the same man, there is every probability that he would have the chief dimensions of the main parts progress in some fairly regular way proportionate to the base size. But with the work done by different men and at different times it is not strange that wide divergence from such regularity and uniformity creeps in. It is so much easier, and so much quicker also—and no "un-

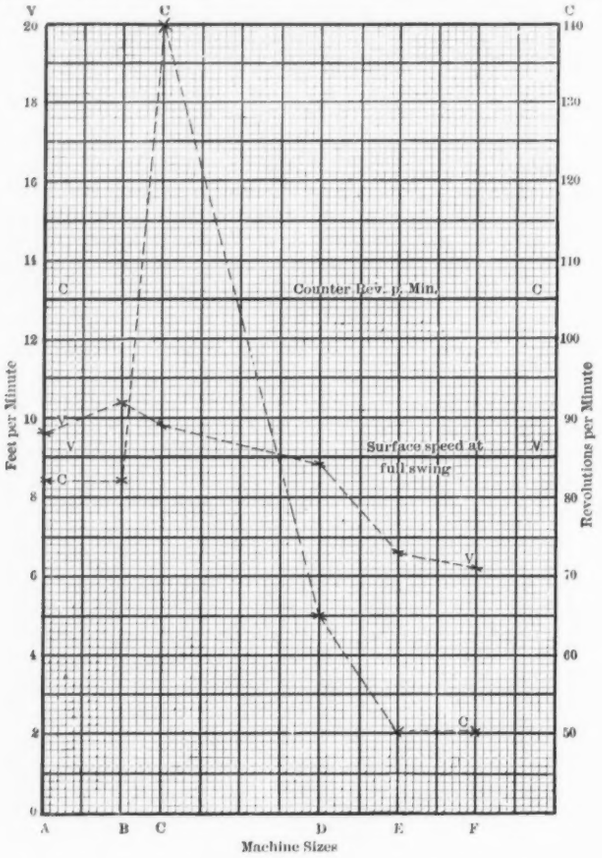


FIG. 1

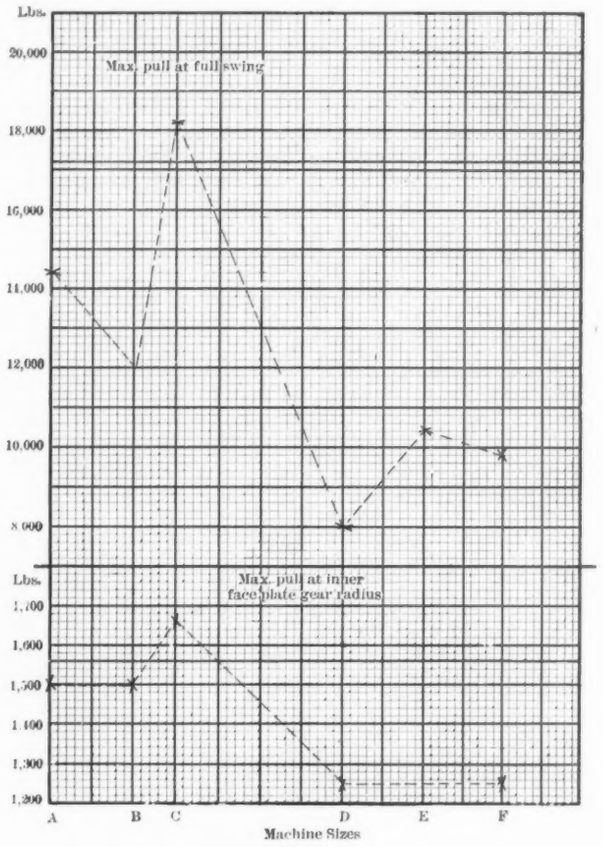


FIG. 2

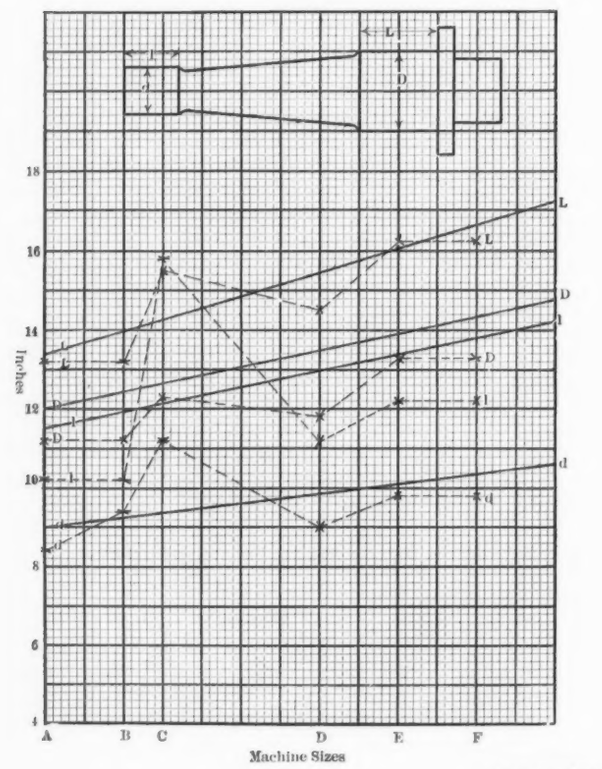


FIG. 3.

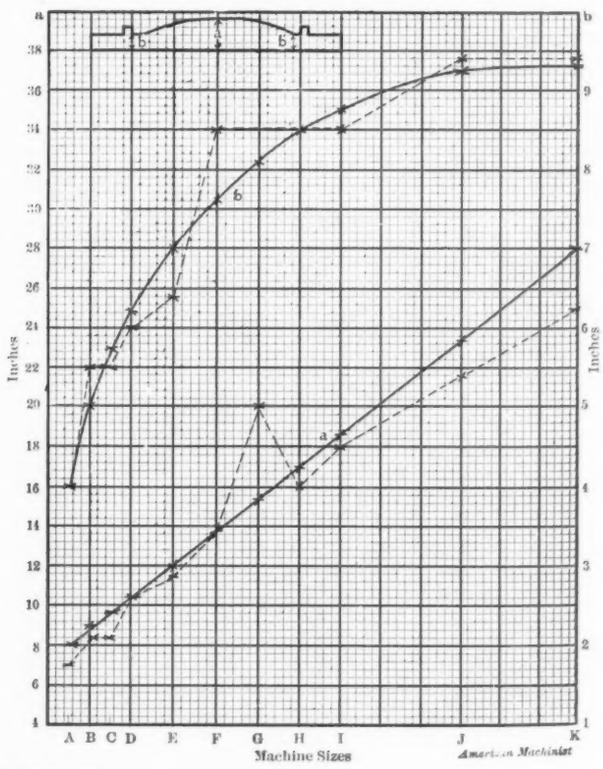


FIG. 4.

PROPORTIONING MACHINE PARTS.

productive draftsman" ever did work fast enough anyway—to rely on personal judgment and recollection rather than hunt up and compare with the dimensions of machines on either side of the one in hand. The results can be seen in Fig. 1; that gives the greatest surface speed at the largest swing of a series of certain special lathes for turning hard materials at slow speed, and also the countershaft revolutions per minute. The dotted lines connect points from the practise of one of our best known shops. It is really difficult to see any justification for the very erratic course of these lines. The same thing holds for Fig. 2 that gives the maximum gross pull. That such erratic proportioning is not necessary is shown by the fact that in redesigning the series the full horizontal lines shown on the diagram were found to be quite realizable without causing trouble in the proportioning of other parts. In determining on the new dimensions a small, medium and heavy machine were considered, and the sizes for others found by connecting the points for these three machines. A similar course gives good results also when the dimensions cannot be represented by horizontal lines, but vary with the base size in some simple or compound ratio. Fig. 3 gives a few main dimensions of a spindle and again shows by comparison of the old dotted and new straight lines the entire practicability of substituting a regular gradation for the erratic one of haphazard design. The same may be said of Fig. 4, that shows the principal dimensions of a series of crossrails.

Actual base sizes and types of machines are not entered on the diagrams given; the dimensions are taken from the actual practise of firms who consider such proportions and sizes as much their private property as the more material articles in their shops or safes. But even in the absence of such information it is clear that there is a decided gain if at the outset the main dimensions of two or three machines are plotted and connected by regular lines or curves. Such work will naturally be done by the best and most experienced man available; then later on, when intermediate machines are to be worked up, men of relatively small judgment can be relied on to do the work by simply picking sizes out of the diagrams, and thus leave the high-priced head man free to devote himself to other matters. The resultant

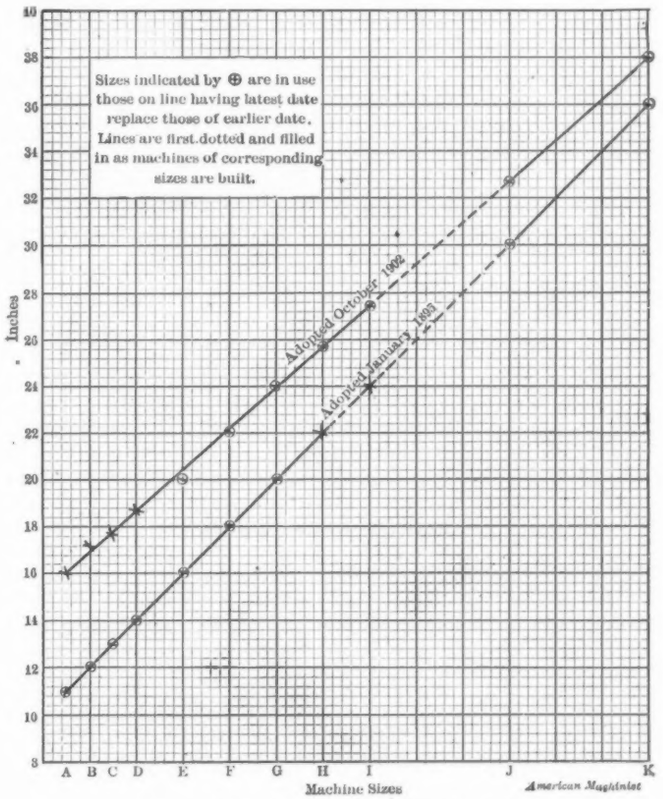

Sizes indicated by ⊕ are in use those on line having latest date replace those of earlier date. Lines are first dotted and filled in as machines of corresponding sizes are built.
Adopted October, 1902
Adopted January, 1895
Inches
Machine Sizes
A B C D E F G H I J K
American Machinist

FIG. 5. PROPORTIONING MACHINE PARTS.

regularity of practise also has its decided value. That not a little time will be saved is almost self-evident.

It may be objected that entire series of machines do not, "like Minerva, spring full panoplied from the head of Jove," and that practise is continually changing in the direction of greater size and weight, particularly in machine-tool practise. There is no gainsaying that; the course to make use of is shown by Fig. 5, in which the lower line shows the sequence of sizes adopted January, 1895; the upper line shows the new proportions that advance in practise has shown as desirable by October, 1902. The full portions of the lines show for what machines the dimensions were translated into actual practise; a note on the diagram instructs everyone concerned that when the redesign of old machines is carried out, it is to follow along the new lines.

To many there may not be much of essential novelty in this, but so surprisingly little use is made of this method of securing uniformity of design as to warrant the representation.

A Compressed Air Motor as a Refrigerator.

The *Revue Industrielle* tells of a brewery in Paris in which the exhaust from a compressed air motor is used for refrigerating purposes with quite satisfactory results. In this case an old steam engine with cylinder 17.7 inches in diameter and 35.4 inches stroke, at 60 revolutions per minute drives a dynamo which supplies 45 arc lamps and 50 to 400 incandescent lamps, the horse-power varying from 30 to 45. The use of an old steam engine, with the usual valve adjustment of such an engine, although quite common in connection with the compressed air service of Paris, is, by the way, not the most economical way of employing the air. The air comes to the compressor at a gage pressure of 71 pounds and at a temperature of 53 to 59 degrees Fahr., sometimes going to 68 degrees; the temperature of the exhaust has been as low as —76 degrees. The exhaust pipe discharges into the freezing chamber, which is in two parts, the first for freezing and the other for storing the ice, the entire chamber being heat-insulated by blocks of ground cork covered with wood sheathing. Besides these chambers there is a beer cellar to be cooled. The pipe, which is 7 inches, is enlarged to 15 inches in the wall of the freezing chamber. Valves are provided for directing the current so that what is not required for the refrigeration goes by a shorter route to the atmosphere.

The compressed air costs at the rate of 4.45 cents per 1,000 cubic feet of free air and the consumption per horse-power hour is about 847 cubic feet. The cost of the compressed air and the running of the apparatus is computed to be no greater than would be the cost of ice necessary to produce the same refrigerative effect, so that the entire lighting plant is practically operated for nothing.

Chancellor Day, of Syracuse University, had this to say in this city a few days ago:

"I would send a son of mine to college if he was going to drive a humble mule through the streets behind a coal cart, because I would want to have as much distance as possible between my son and that mule.

"The bare chance that there may be one great inventor in a whole century pays the bill of every university, every college, and every seminary from the Atlantic to the Pacific, from the Northern snows to the Southern palms."

The college would be likely to develop the necessity of looking for another driver for the mule.

Letters From Practical Men.

Some Drafting-Room Kinks.

Editor American Machinist:

It is quite frequently the case that little schemes may be used in a drafting room which help a great deal in reducing labor and bettering the output. For cross-sectioning there is nothing better or quicker than a 4-H pencil rubbed on the dull side of the tracing cloth. It is much better than ink hatching, because it is easily erased when it is necessary to make corrections, and dimension figures can be placed right over sections and print distinctly. I have tried both the dull side and the glazed side of tracing cloth, and I used the dull side for quite a time in my office, but have come to the conclusion that the glazed side is the proper side upon which to draw. The only advantage that I have ever heard claimed for the dull side was that it does not have to be powdered. Long experience in the use of practically every tracing cloth that is offered on the market has shown that there is more theory than practice in this assertion. I never saw a tracing cloth yet which could be used upon the dull side without dusting it first with some form of tracing-cloth powder.

For erasing ink lines on tracing cloth I have discovered that Faber's Ruby rubber fulfills every requirement. It not only erases ink from the glazed side of tracing cloth with promptness, but leaves a surface which can be inked without burnishing and which will not pick up dirt. The erasure made with the Ruby rubber is scarcely noticeable, excepting when looking at the drawing at a very acute angle.

To make tracings lie flat when put in a drawer it is an excellent plan to make a medium heavy border line *on the back* carrying the ends to the extreme edge of the cloth, so that the lines cross at the corners. This gives the edges a kink the other way and prevents them from rolling up. While I am not accustomed to giving manufacturers a free advertisement, I have seen many schemes for adjustable angles and protractors, but not one of them is nearly so convenient as the Brown & Sharpe draftsman's protractor. This is an instrument that can be used either side up, is extremely accurate and can be set without difficulty to five minutes of arc.

I note in a letter from Mr. Lyne, at page 318, that he favors beginning the graduations of a draftsman's scale at the extreme end instead of about ¼ inch from the end, and wonders what is the reason that manufacturers do not graduate from the end. It would seem that the reason would be only too apparent, as no matter how careful a draftsman may be, he will occasionally drop a scale on the floor, and nine times in ten it will fall on the corner, damaging the graduations if at the end. For myself, I have no use for anything but a steel or brass scale, and I prefer the triangular form to any other. A measurement can be very accurately and quickly made by sliding a needle or pin down the graduation groove. I always keep a paper of black-headed mourning pins among my supplies and use them for laying out work with the assistance of a triangular scale. Not nearly such accurate work can be done with a pencil as with a needle point, and the latter has the advantage that it does not wear out rapidly or break off at the slightest provocation. Save me from the celluloid-faced rule. I have a slide rule knocking around my office, on which the celluloid facing has come loose and has shrunk nearly 3-32 inch in a length of about 10 inches.

I am rather at a loss to understand why an up-to-date draftsman will stick to the out-of-date T-square, especially on long drawing boards. In my estimation they are even worse than a nuisance, and some four years ago I fitted up all my drawing tables with the wire-controlled parallel straight-edge, the advantages of which are many.

There has been a great deal of discussion in the AMERICAN MACHINIST regarding the numbering of parts. I make designs for a great many firms and find the favorite method among gas engine and automobile builders is continuous numbering. The only valid objection I have heard to this is, that it is difficult to get large numbers on small patterns.

Quite frequently I am called upon to submit a preliminary drawing in order to secure a contract for designs. The better the work the better the customer will be pleased, particularly in case he is organizing a stock company upon the strength of the preliminary drawing. In this class of work a nicely lettered title is an absolute necessity. I have found that the quickest way to get out a title is to have it set up in type by a printer and then slip it under the tracing. It requires some skill, of course, to trace printed letters, but the results are good and the time of laying out is saved. I know that some titles are printed directly upon the tracing cloth, but unless you have a press in your own office this would be out of the question, as it is by no means safe to trust a fine drawing in the hands of a printer. Besides, I have found that large printer's type is apt to be very ragged around the edges of the letters. I am aware that rubber stamps and gummed letters have been employed for this purpose, but they are not satisfactory for show drawings and will not answer. It is next to impossible to get a gummed letter on absolutely straight.

One of the most difficult things for the ordinary draftsman to make sightly is the top view of the elevation of a hexagon nut, particularly if the drawing is to a small scale. The best way to draw the top view of the nut is as shown in Fig. 1. The sides of the nut are drawn tangent to the inner circle. Too many draftsmen attempt to draw the sides to the outer circle indicated by dotted lines. This almost always results in making the drawing lopsided. An elevation of the nut where the drawing is anyways particular as to appearance should be made as in Fig. 2. Make the radius R equal to the distance between the two sides of the middle flat. Usually this will be the hight of the nut. Continue the circle in the pencil drawing until it crosses the lines running through the centers of the side flats. This will give the center of the radius r for the smaller circles. I always take pains in a drawing of this kind to measure off for the center lines of the side flats, otherwise the elevation is very apt to look like that shown exaggerated in Fig. 3.

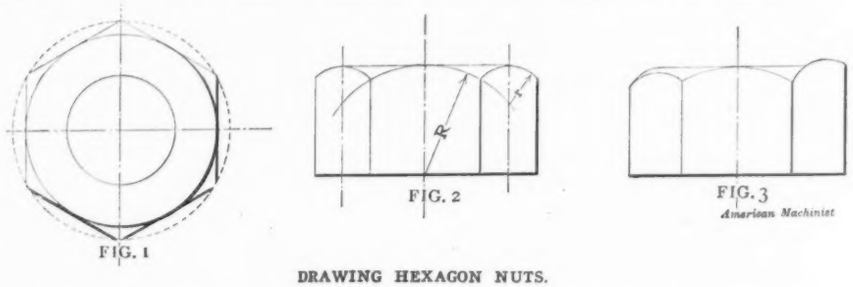


FIG. 1 FIG. 2 FIG. 3

American Machinist

DRAWING HEXAGON NUTS.

There have been published many schemes for saving blueprints that have been overprinted and for getting good prints out of old paper, but I have not seen the equal to the plan of a Chicago concern, which is to use a saturated solution of bichromate of potash. If a print has been overexposed or "burned," pouring the bichromate solution directly upon the face of the print will quite frequently save it. When using very rapid paper, which in bright sunlight prints in from 40 to 50 seconds, the average run of prints will have a greenish hue, but by giving them double the usual exposure and then washing them with one or two quarts of a saturated solution of bichromate to a pan of water the prints will come out a beautiful dark blue. Since hearing of this solution I always keep a pan of bichromate of potash alongside my blueprint tray to be ready in case of accident. By using this I have saved many a print that would otherwise have been lost from over-exposure. It is particularly useful on a semi-cloudy day when the light is rapidly changing, for the sun may suddenly break through the clouds and shine upon the print, hastening it and very likely burning it up.

A great many draftsmen have abandoned

the thumb tack altogether and use the ordinary 1-ounce steel tack, as they do not interfere with the straight-edge and angles as thumb tacks do. In connection with these tacks a magnetic hammer is very handy and is used by a great many draftsmen.

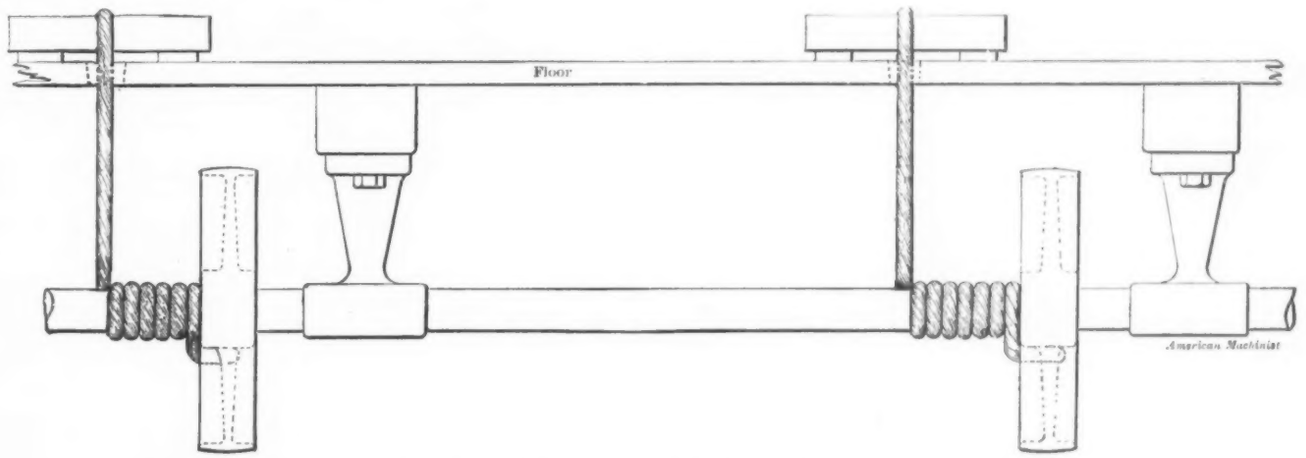
One of the greatest mistakes made by young draftsmen and one that makes them very slow in getting out their work is not keeping their pens clean. I have seen more than one draftsman fuss with his pen to get the ink to flow simply because the ink had dried on the pen-points. One of the first things a draftsman should learn is to wipe his pen *every time* before laying it down. Another advantage is that if the pen happens to roll across the drawing it will not leave a mark, if it has been wiped clean.

It is amusing to go into some drafting rooms and see how many draftsmen turn up their noses at curves. I remember going into a drafting room in Wisconsin in which two or three old hands jollied me unmercifully about using curves, but before I had been there ten days the man that had made the most fuss about it was borrowing curves of me.

The practice in various engineering establishments is to keep the workman from scaling the drawing. While this is standard practice in many of the large concerns there is still too much scaling done. I believe every drawing that is dimensioned should be marked "Work to Figures Only" or have some similar inscription. I have been in places where they used the system referred to, but when I made a drawing to a scale of 2 or 4 inches to the foot the head draftsman raised a great hullabaloo, and I found that it was because the workmen would not be able to scale the drawings.

There is a point in factory drawings in which there is a great difference in practice, namely, the method of designating the number of pieces to be made from a detail. Some will call for "2 of this," another "2 off" and another "make 2." How much simpler it is to write the title thus, "2 Cylinders—Gray Iron" or "2 Gray-Iron Cylinders." While greatly in favor of simplifying the work as much as possible, I think a little more work in the drafting room will in many cases save a lot of misunderstanding and confusion in the shop. I believe it is better practise to avoid the use of dotted lines whenever feasible and employ cross-sections instead. This makes a little more work in the drafting room, but it saves an awful lot of work in the shop, particularly the pattern shop. I find the use of this method particularly beneficial when having patterns made at a distance, as a first-class patternmaker will very seldom make a mistake if he has a sufficient number of views. Placing the same dimension twice upon the same drawing—that is, upon two different views—is bad practice for the reason that in checking up or making alterations one dimension will be corrected and the other very likely overlooked, and it is generally the one that is wrong that the patternmaker or machinist is likely to use.

A great deal might be said about systems of checking drawings, and while practically every designer appreciates the necessity of a thorough system of checking there seems to have been very little written about it in the technical papers. I suggest that the systems of checking used in some of the larger engineering establishments be discussed in the columns of the AMERICAN MACHINIST. E. W. ROBERTS.



AN IMPROVISED HOIST APPLIED TO A LINE SHAFT.

An Improvised Hoist.

Editor American Machinist:

I was once called upon to suggest some practical way to take down and put up a heavy line of shafting, about 150 feet long, having a large number of pulleys ranging from 2 to 5 feet in diameter. It was the main shaft for a wood-working plant. There were no pulley blocks or tackle of any description to be had, and this shaft must be taken down, some pulleys removed, others put on, and be back in place between quitting time Saturday night and starting up time the following Monday morning. This line of shafting and its pulleys would weigh several tons, and without tackle it seemed quite an undertaking. I had very little time to consider the matter, being on my way to the railroad station to take a train, but suggested the following described plan, which proved a success, the proprietor assuring me that it was better than any blocks or tackle he ever used or heard of.

My recollection is that they used six pieces of rope of suitable length, 1¼ inches diameter; one end of each rope was made fast to an arm of a pulley—these ropes being located as nearly equidistant as the pulleys on the shaft would permit—then each rope was snugly wound around the shaft until enough in length had been wound so that when unwound they would allow the shaft to reach the floor, or other arranged support. The other end of each rope was then passed up through a hole cut through the overhead floor, and made fast to a piece of timber, these timbers being shimmed up so as to make all of the ropes as nearly uniform in tension as conveniently possible. Of course the holes through the floor were located directly over the point where the loose end of the rope left the shaft. Then all the caps to the hanger boxes were removed and six men rotated the shaft by the rims of as many pulleys in the direction to raise the shaft out of the boxes, when two other men, by using levers swung the shaft clear of the boxes; then the men at the rims of the pulleys let the shaft rotate in the direction to unwind the ropes from the shaft, which of course lowered the shaft with perfect ease and safety. Of course the raising of the shaft was simply a reversal of the action of lowering. A portion of this shaft was 4 and the balance 3 inches in diameter, and they wound some old sacking around the 3-inch, so as to make it 4 inches where the rope was coiled on it. Of course they had to arrange something for the men to stand on, as they could not reach from the floor.

I have used this plan several times since very satisfactorily, and in doing so have not as yet found anyone that had ever

seen or heard of its use before, which indicates that it is not generally known, tho of course so simple a thing must have been used. JAMES BRADY.

New York.

Spring Guard for Drawing Cabinets.

Editor American Machinist:

The device illustrated is an effective guard or clamp to prevent the ends of drawings from catching when opening or closing the drawer. It is particularly good when used on shallow drawers. Our filing cabinets are made on the "sectional bookcase" plan, each section having ten drawers, 1⅝ inches deep inside. They accommodate 100 tracings easily and are equipped with this device. The shallow drawers give an economy of about 50 per cent. in space as compared with most of the ordinary cabinets.

For drawings up to 12x18 inches the guards are made of No. 10 coppered iron wire, are 7 inches wide and extend 7 inches from the ends of the drawers. For drawings 20x26 to 24x36 inches No. 9 wire is used, the larger size being 15 inches wide and extending 7 inches from the ends.

It will be noted that each drawer is equipped with a movable spring guard *A* at its front end and a stationary guard B at its rear end, Fig. 1.

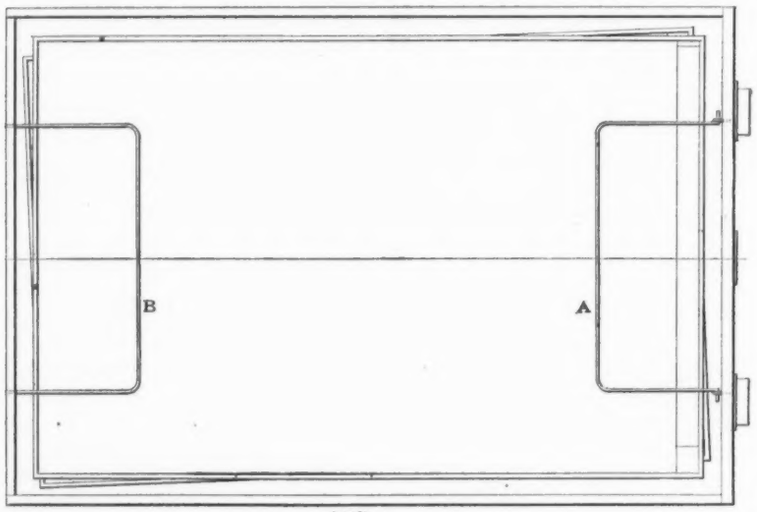


FIG. 1

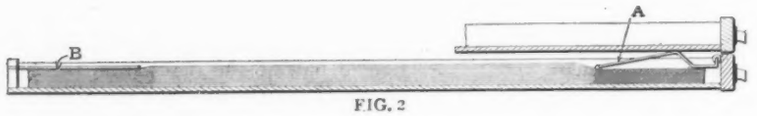


FIG. 2

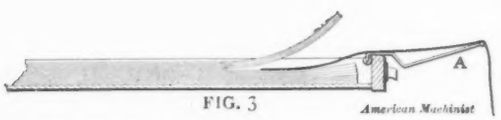


FIG. 3

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SPRING GUARD FOR DRAWING CABINETS.

The rear guard is fastened by simply pressing the ends into holes just a trifle smaller than the wire. The front guard is secured by two small screw eyes in the manner shown, the ends of the wire being sprung apart before inserting into the eyes. The manner of operating is shown in Fig. 3, where *A* is thrown outwards, clearing the drawer for action and also serving as that "third arm" or hand we so often wish for, by holding the tracing at a distance from the drawer, permitting the boy to use both hands to greater advantage when inserting drawings, especially when near the bottom.

In Fig. 2 a section of one of the drawers so equipped shows the guards when in repose. The hump on guard *A* is bent a trifle higher than the top of the drawer, so as to gently press against the bottom of the drawer above, thus holding the drawings from sliding when the drawer is moved.

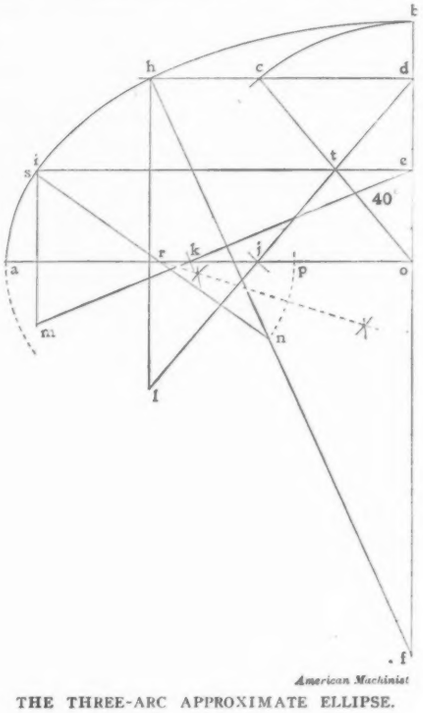
The drawings do not become chafed in the least. GEO. K. SMITH.

Approximating the Ellipse by Arcs of Circles.

Editor American Machinist:

The use of circular arcs to form the figure of the ellipse may often be advantageous, as the centers of the sectors may be used for drawing parallels to the parent curve and normals to the curve may be easily drawn. I have seen some efforts in your pages to show how to form the approximate ellipse with a two-arc method of construction, but the resulting curve would not be satisfactory, except when the major axis is not much in excess of the minor axis.

Having given the subject some attention and having arrived at a satisfactory treatment for producing the approximations under consideration, I submit a drawing of a three-arc case, believing that the method covers general principles of construction that will enable the draftsman to increase the number of sectors,



American Machinist

THE THREE-ARC APPROXIMATE ELLIPSE.

and thus meet the requirements of all cases. A rough rule to determine the number of arcs suitable to a case is as follows: If the axes are as 2 : 1, use three arcs; if as 3 : 1, use four arcs, and so on, and reduce the greater sector from the 40 degrees shown on the drawing to 35. A two-arc case should not exceed an axes ratio greater than 1.25 : 1, and use 45 in place of 40 degrees.

Referring to the illustration, *o a* is the semi-major and *o b* the semi-minor axis. Draw the sector *o b c* = 40 degrees, and through *c* draw *d h* parallel to *o a*. On *d* as center, with radius *o b*, intersect *o a* in *j* and connect *d j* produced to *l*, *d l* to be equal to *o a*. Draw *l h* parallel to *o b*, intersecting *d h* in *h*, then *h* will be a point in the true ellipse. Through *t* draw *e i* parallel to *o a*, and with radius *o b* and center *e* make intersection at *k* on *o a*. Join *e k* produced to *m*, *e m* to be equal to *o a*. From *m* draw *m i* parallel to *o b*, intersecting *e i* in *i*, then *i* is another point in the true ellipse. On *b o* produced find center *f* for radius to strike arc *b h*, and connect *h f*. On *h f* find center *n* to strike arc *h i*. Make *a p* = *h n* and find center *r* on *o a* that will strike arc *n p*, and join *n r* produced to *s*; then *r s a* is the closing sector completing the quadrant.

When the case requires a four-arc treatment, divide *d e* into three equal parts for two parallels in place of one, *e i*; also make sector *o b c* = 35 degrees instead of 40; but for a five-point case or more, retain the 35 degrees and draw equally spaced parallels between *o d*.

Orillia, Ont. W. H. CROKER.

Melting Chips in the Cupola.

Editor American Machinist:

I have read with much interest Mr. Osborne's account, at page 441, of his experience with the use of gray-iron chips in the cupola, as it is quite in line with my own. I have put the chips in loosely and have confined them in boxes and have tried them also in various stages of the charge, and have not found that I got enough out to compensate for the value of the chips when sold to the junk man.

It has occurred to me since that there might be another way out of the difficulty, but, not having an opportunity for trial, possibly Mr. Osborne might consider it worth while. I remember very well that the pavements in front of the old L. W. Pond Company's shops in Worcester, Mass., were made up of the accumulations of chips laid down in place of cinders, and that this pavement was of extraordinary solidity. You are also no doubt very well aware of the compact masses that such chips will form if they are allowed to get wet sufficiently to rust together. Now, might it not be well to convert the chips into fairly solid lumps by rusting them, possibly accelerating the process by the use of sal-ammoniac?

HENRY HESS.

Editor American Machinist:

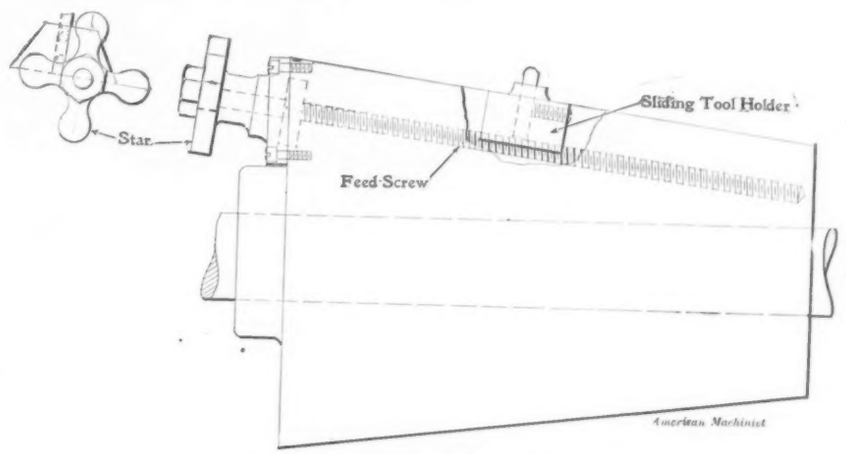
In reading Mr. Osborne's interesting article on melting gray-iron chips at page 441, in which he calls for others' experiences, I would state that in order to dispose of our machine-shop chips I have them placed in old or broken flour barrels, etc., and saturated with salt water, made by taking about two-thirds of a pint of salt to three gallons of water, which is thrown in on one-third of a barrel of chips. This done, the chips are packed down slightly with the end of a stick or other pounder to make them lie solid. After two more such operations the barrel is filled and let stand for three weeks or longer to allow the chips to become rusted together so that when the barrel is broken they are in a solid body. This body is now broken up with iron wedges and a sledge to convenient size for charging with the pig-iron and shop scrap into the cupola. We have never been in a position to make any tests as to what we procured from the chips, owing to the heavy character of our heats and castings. If Mr. Osborne is in position to test our plan I for one would be pleased to hear from him through the AMERICAN MACHINIST. I would state that care must be taken not to use too much salt, as it can do more harm than good towards making a compact body and causing loss by rust.

THOMAS D. WEST.

Boring-Bar for Taper Holes.

Editor American Machinist:

I was interested in the description at page 145 of a boring bar for taper holes. Enclosed is a rough sketch I have made which I think will show clearly enough another device for boring a large taper hole. This tool I planned and had made many years ago, and it does its work well.



BAR WITH HEAD FOR BORING TAPER HOLES.

X. Y. Z.

Squaring Mixed Numbers Ending with ½ Mentally

Editor American Machinist:

Many draftsmen when required to square a mixed number ending with a ½—for example, 3½, 9½, etc.—will take time to look it up in a table of squares or multiply it out, when they could square it mentally. Take, for example, $3\frac{1}{2}^2 = 12.25$. The formula tells us that the square of the sum of two quantities is equal to the square of the first plus twice the product of the first and second plus the square of the second. The middle term is always equal to the integer because $2 \times \frac{1}{2} \times \text{integer} = \text{integer}$. We have therefore only to square the integer, add the integer to the result and annex ¼ (the square of ½) in order to get the answer.

By the use of this formula we can square a number ending with 5—for instance, to square 65, take 6 as the integer and treating the 5 as ½, we square $6 = 36$, add 6, giving 42, and then annex ¼ (.25), which is the square of .5, giving $42.25 = 6.5^2$, and moving the decimal point $4225 = 65^2$.

O. C. BORNHOLT.

High-Speed Steel for Finishing.

Editor American Machinist:

We have been experimenting for some time with the new high-speed steels, and altho we were a little skeptical at first about using it for finishing work, we now have no doubts about its being just as much of a success for finishing as it is for roughing. When using high-speed steel for finishing we get the best results by having a steady stream of oil flowing on to the point of the tool, for we find it the best practise when finishing to keep the tool as cool as possible and let the work absorb most of the heat, and of course the oil produces a better finish also.

The material on which we have been experimenting is steel of a very hard grade, so hard that tools of ordinary tool steel will not stand up more than half an hour at a surface speed of 25 feet per minute with a feed of 120 per inch and ⅛ inch reduction. This is an ordinary roughing cut and will give some idea of the hardness of the steel we have to turn. About .010 inch is left for finishing, and the limit of accuracy is .002 inch with one chip, so that the greatest saving by the use of the high-speed steel for finishing is not in the increased speed, but in the time saved by the length of time the tool will last. There is less grinding of the tool and the work is kept more nearly to size by not having to change tools so often.

We also use high-speed steel for thread cutting and have great success with it. We have a job of thread cutting which is quite interesting. The work is 20 inches long and ⅞ inch diameter with a two-pitch thread on one end 3½ inches long; material, hard steel. This thread is round, 7-32 inch wide, 3-64 inch deep. With tool-steel tools about ten pieces could be done with one grinding of the tool, taking eight chips at 60 turns per minute. Increasing the speed of work to 100 and using high-speed steel 100 pieces could be done with one grinding of the tool, taking six chips.

When we received an order for 500 of these pieces ¾ inch diameter with a 14-pitch V-thread, instead of the 2-pitch thread, we did not expect to have any difficulty in cutting the threads until we started to cut them, and then we found out what we were "up against." This order came in during the week when we began experimenting with high-speed steels. When we started to cut them we used tool-steel tools, and the best we could do was to do two pieces per hour and grind the tool twice on each piece. After we had tried to cut a few, somebody suggested that we try some of the new steel, so as we were getting desperate we had a tool drawn out and by the time we had taken three chips over the piece we knew that our troubles were over. High-speed steel had solved the problem.

The first tool made of high-speed steel

was heated till the point burnt off and then plunged in oil. The second one was heated to the same heat and cooled in the air blast and from this one we got the best results, the work running at 80 revolutions per minute and taking about twelve chips and averaging ten pieces to one grinding of the tool, in one case doing twenty-one pieces. In doing the whole 500 pieces the point of the tool did not break off once. Under these conditions a rate of six per hour was easily averaged.

PAUL WESLEY.

Reboring a Locomotive Cylinder With an Air Drill Drive.

Editor American Machinist:

It is, I believe, common practice in locomotive shops, when an engine comes in to be repaired, to rebore the cylinders without taking them off the engine, which, of course, necessitates a special rigging or fixture. If all the shops do not follow this practise we do, and have done so for years. Heretofore we have used a movable stand with a pair of tight and loose pulleys, but a few days ago, for some reason or other, that rig was out of commission and an air drill was put into service. This proved very satisfactory as long as the pressure was even. Of course at times there would be more air machines, drills and hammers in use than at others, which naturally affected the speed and power of the drill that we used on the cylinder; but as only very light cuts were taken it did not bother us much in the way of power. We used a No. 0 (or size 0) Little Giant air drill, which at 80 pounds pressure produces 3½ horse-power, the spindle making 150 turns per minute.

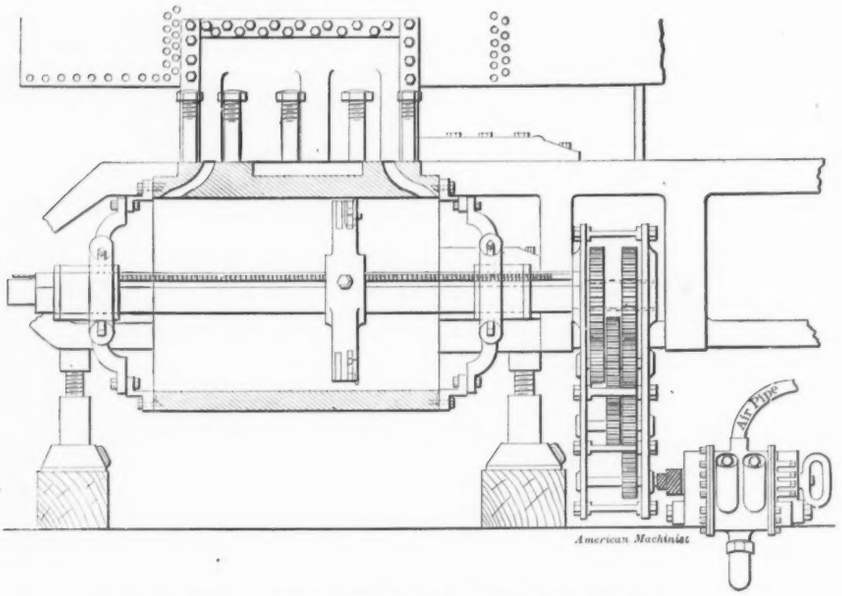
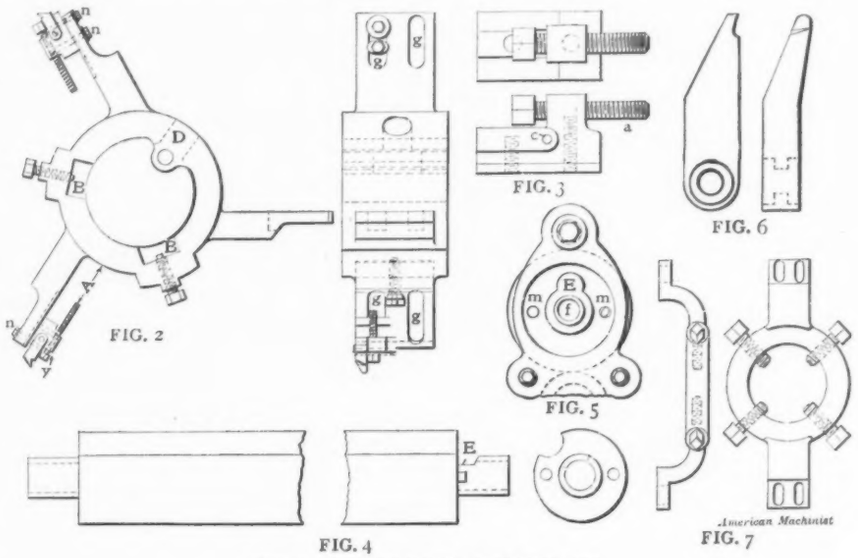


FIG. 1. RIG FOR REBORING LOCOMOTIVE CYLINDERS.

The accompanying sketches will for the most part explain themselves. Fig. 1 shows the forward part of the engine held up by four jacks, two on each side, the forward wheels having been removed to be turned. The cylinder is shown in section in order to show the boring bar and arm in working position. The bar is driven by the train of gears, as shown, reducing the speed at which the spindle of the air drill revolves, which is 150 revolutions per minute, down to about 10 revolutions per minute for the bar. The air drill is shown connected to the shaft of the first pinion merely by a socket.

The boring arm or star is a single casting with two places planed or slotted in to hold two pieces of steel *B B*, Fig. 2, which act as gibs, these being adjusted to the bar by the screws which back them. Opposite these pieces is a place cored out for a brass nut through which the feed screw goes. There is also a hole drilled in the casting itself which helps to steady the screw. At *y* is shown a tool-holder and a tool in position. One arm is left free in the drawing to show its shape more plainly. It will be noticed that the faces of these arms are set a certain distance back of the radial line; this is to bring the tools on the line. The tool-holder is bolted on to the arm by bolts running up through the slots *g* and screwing into the holder or block, as shown. The tool is in form like any common "rooter," only slightly bent, as shown in Fig. 6, with a ⅜-inch hole drilled in the back end and counterbored, through which a screw bolt passes,



DETAILS OF CYLINDER REBORING RIG.

going through hole *c* in the block with a nut and check nut on the other end. The screw *a* is merely to take the strain off the clamping screws *n n n* by tightening up against a block put in place marked *A*. By means of this it is also easy to move the tool out a very little at a time to adjust the cut.

The boring bar is merely a round shaft with a groove cut in it for the screw, the ends are turned smaller and one end is bored or drilled and in this goes a gear which meshes with a gear on the end of the feed screw which goes in place marked *E*, the center gear being held from turning; consequently, as the bar rotates, the gear on the feed screw travels around the center gear, thereby causing an independent movement of the screw which, consequently, causes the boring arm to travel from one end of the bar to the other; there are two pins driven into and projecting from the end of the boring bar (see Fig. 4) which fit into pin holes marked *m m* in the gear plate, thus acting as keys or drivers; the shaft or spindle on which is the stationary gear *g* is independent, so that when it is desired to run the arm back and forth on the bar the spindle is released by means of a clamping device not shown, and a hand-wheel is slipped on the back end, and when desired to put the power feed on it is merely clamped tight again.

The bar runs in two sleeves which are held in place in the two end brackets (Fig. 7) by adjusting screws as shown.

Providence, R. I. L. E. SALMON.

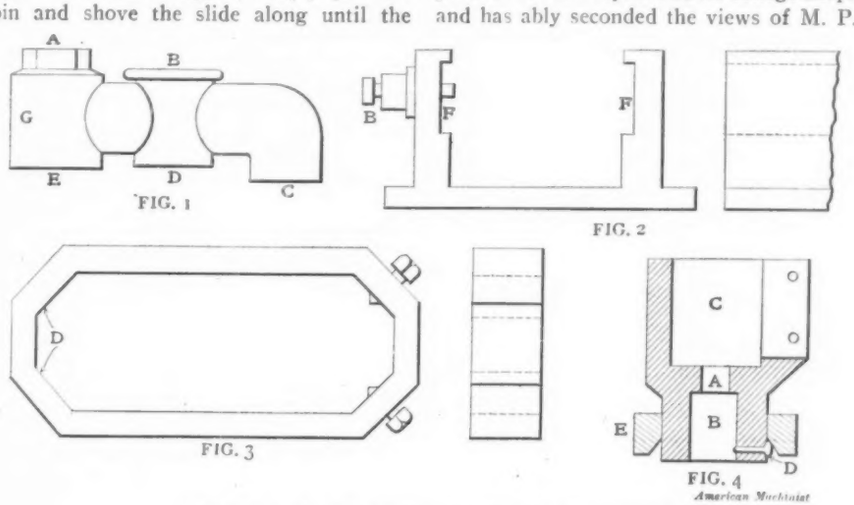
A Jig and a Chuck for the Drill Spindle.

Editor American Machinist:

I send you a sketch of a jig for a comparatively simple job. The casting, Fig. 1, is to be sized in the holes and tapped to pipe sizes as follows: *A*, 1¼ inches; *B*, 1½ inches; *C*, 1¼ inches; *D*, 1½ inches; *E*, 2½ inches. The edge at *E* is also faced. The work is all done at one fastening of the piece in the jig, Figs. 2 and 3.

Fig. 2 is the body or standard of the jig. The bottom *A* is planed and is permanently bolted to the face-plate of a turret lathe. The two grooves *F* are planed as shown.

Fig. 3 is a slide fitting *F* on Fig. 2. In this slide the piece to be machined is held. The end *G* is forced tight against the bevels *D* by the two pointed set-screws at the opposite end. The slide is located in the right position to bring the tools in line with the casting holes by spring pin *B*, holes of course being drilled in the slide for each position. When the first hole in the casting is bored and tapped, simply pull the pin and shove the slide along until the pin drops into the next hole, and so on. When one side is finished pull the slide out, slip it in the other way and proceed as before.



A SIMPLE JIG AND CHUCK FOR THE DRILL SPINDLE.

These castings could have been handled in the same jig on a drill press with a proper chuck to facilitate rapid changing of tools, but we have no press in the department with sufficient power to drive a 2½-inch pipe tap. By the method used in getting out the piece before the building of this jig, work on the castings cost 24 cents for each. The operator had to do one hole in the whole batch and then the next hole in all of them, and so on, so that if the assemblers were in need of the castings they had to wait until the machine operator had the entire batch done, with the exception of the last hole. By the use of this jig one piece is finished before another is started and at a cost of 12 cents each. The jig cost about $5 to build.

Fig. 4 is a chuck for the drill press and adapted for use in connection with the above jig. There are modifications of this chuck on the market, but they don't seem to be as extensively used as they deserve to be. *C* is bored to fit the spindle of the drill press and is split so that it will clamp securely. *B* is bored to fit the shanks of the tools. *A* is cast flat on two sides to drive the tools, while *D* is a tool-steel pin which is held into a groove in the tool shank by the collar *T*, holding the tool from dropping out.

To put in the tool, simply raise the collar and shove the tool in, then let the collar drop, and your tool is in to stay. When the collar is raised again the tool drops out. The principal advantage of this chuck is that no wrench is needed, and in a majority of cases the tools can be changed without stopping the machine.

GEO. S. HALEY, JR.

Laboratory vs. Shop.

Editor American Machinist:

I believe that W. S. Leonard (at page 406) has in no uncertain terms fully declared and defined the spirit that should pervade the atmosphere of all college shops and has ably seconded the views of M. P. Higgins who, more than a generation ago, conceived and put into successful practise what is known as commercial shop work in the Worcester Polytechnic Institute. The same kind of seed has been planted in Cornell and other reputable colleges, and from the parent stocks several shoots have been transplanted in the secondary institutes, manual training schools, and trade schools of the country. On the other hand, we have reputable colleges, secondary institutes, manual training schools and trade schools which pledge their faith and stake their reputation on a course of elementary and progressive exercises. The advantages and disadvantages of each have been pretty fully exposed in the contentions of the representatives of the respective institutions and, in the ordinary course of events it would be expected that one or the other of the methods will change since the graduates of all of them compete in a common field for commercial success.

It is sometimes rather difficult to define exactly what the aim of a college of engineering is, or to predict what the end of her graduates will be, but it is believed that we all stand on common ground when we claim that if the aim of every engineering college is to teach her students in a scientific manner, then the end of things for the students will be most satisfactory. The vital question then is, what is the scientific method? With the two opinions referred to above and which are diametrically opposed to each other, there is a third which straddles the issue in a combination of the other two. One institution, teaching her students what is practically the elements or fundamentals of shop practise, says "amen" with a keen satisfaction that they are exercises in the laboratories of the mechanic arts. Another institution attempts to teach her students how to work with the purpose of accomplishing the degree of work which would be expected of a skilled journeyman mechanic. And the institution which combines the practise of the other two promotes the idea that it is much more scientific to observe how things should be done than it is to literally do them.

Unless he is a proven prodigy or is unhappily blessed with family succession no fresh graduate of an engineering college expects to be able to assume the responsibilities of a superintendent, works manager, or any leading position of a concern of any considerable size without having a fair amount of field experience. But if he is properly constituted with the "get there" spirit he will want to learn in the shortest possible time all there is worth knowing to fit him for an authoritative position in the affairs of any engineering project which may present itself.

It is conceded that usually the well-rounded man who merits success in any profession is the one who knows his business at A as well as at Z, and if necessary can talk it backwards from Z to A without a miss. If this is sound logic it clearly means that the essence of the manual training course should be taught at some period, but, undoubtedly, preferably in a regular manual training school or trade school course. If only the bare manual training course is taught in a college there is an unnecessarily wide gap for the young man to span when he emerges from college halls to be submerged by the exacting requirements of the life a hustling manufacturing plant.

If we teach the proper shop course we are bound to embody most of and possibly more than the fundamental features which are taught in the manual training school and at the same time the spirit of commercial life is awakened.

It is undoubtedly a good thing to start a boy right and to start him early and perhaps at first give him his food in such quantities that he can fully digest it and then see to it that whatever he attempts to do is rightly done. If it is to be rightly done, a great many things and everything must be done right; for instance, if

a boy is turning a piece in a lathe, it is not sufficiently right even if he turns his piece perfectly round, parallel, and with a satisfactorily finished surface if these results are obtained by the use of tools improperly set and ground and, what is so unfortunately oftentimes overlooked, at time-killing speeds and nibbling feeds. Right here it might be stated that it is a deplorable fact that many instructors in charge of the shops of our engineering colleges are deadening the spirit of efficiency in the student by a woeful neglect of the proper adjustment of speeds and feeds of his machines. In consequence the student has not the first notion of maximum output under the best conditions, which is of paramount importance in any efficient commercial plant; whereas, in these particular features, the field would naturally look to the engineering college which should be peculiarly fitted for taking the initiative in these respects.

If the laboratory idea is the proper one, why should not research work be pursued along the lines of testing and developing such as high-speed steels, machines experimentally designed for particular purposes, independent machine motor drives, etc.? In other words, why would it not be a good scheme to have an operating room or a clinic where machine tools and attachments, jigs and fixtures could be driven and demonstrated to their maximum efficiency under varying conditions, dissected and analyzed for defective design and reconstructed for improved design? Is not this more properly the function of a college of engineering, the more fitting meaning for the term laboratory, and more in the spirit of harmony with commercial engineering? Why should not the student do his elementary work in the manual training school, and the engineering colleges require such work for an entrance condition? In this way the engineering college raises its course in shop work to the level of the other courses of the curriculum. For the manual training school to teach a semblance of commercial work, as is sometimes done, and for the engineering colleges to teach the simplest elements, as is often done, there is obviously an incongruous relation which should be adjusted without delay. If the engineering college cannot offer her students something better than can be had at a well-graded manual training school, or if she cannot offer her students a course of instruction which is at least abreast of the times, it may then be logical to conclude that a student is better and more economically instructed when he is taken on regular tours of inspection by competent instructors to the near and distant up-to-date, enterprising, manufacturing concerns.

Usually the college does not expect to do much more than to develop a substantial substructure and a certain *esprit de corps* for her students. In a well-established college the student is well grounded in the substructure, but the *esprit de corps* in a great many cases is false to his future interests and a great handicap to the interests of his future employers. It is, furthermore, inconsistent and uneconomical for instructors to try to teach students the art of making machine working drawings —in other words, to make a drawing that is the patternmaker's and machinist's official order for making the piece which is drawn—without a knowledge of all the various methods of doing the pattern, foundry, and machine work, and doing it in the most economical way. Moreover, how can a student comprehend in a thorough manner the advantages of motor drive, comparative efficiencies of high-speed steels, and the salient points in the design of general machinery, when it is discussed and analyzed in the lecture room without a knowledge of the limiting operating functions of the machines?

Undoubtedly, it is often overlooked by responsible faculties that shop work has a wide and intensely useful interdependence with the other engineering courses. The results of the training in the shop cannot help but permeate and ramify all the other engineering courses and either chills them with disinterest or half-interest or makes them glow with a burning desire to compete for something better than has been accomplished. Clothe the college student more with this idea that he must familiarize himself with and analyze the best conditions in modern shop practise, and then that there is something still better on beyond that he must search for, and, by all means, do not hedge or trammel any inventive ability whenever it manifests itself, but rather encourage a constant growth of development in the power of analysis and desire for research and give him that broadness and freedom of engineering ideas which would be respectful to the broadest of all professions within his range of choice.

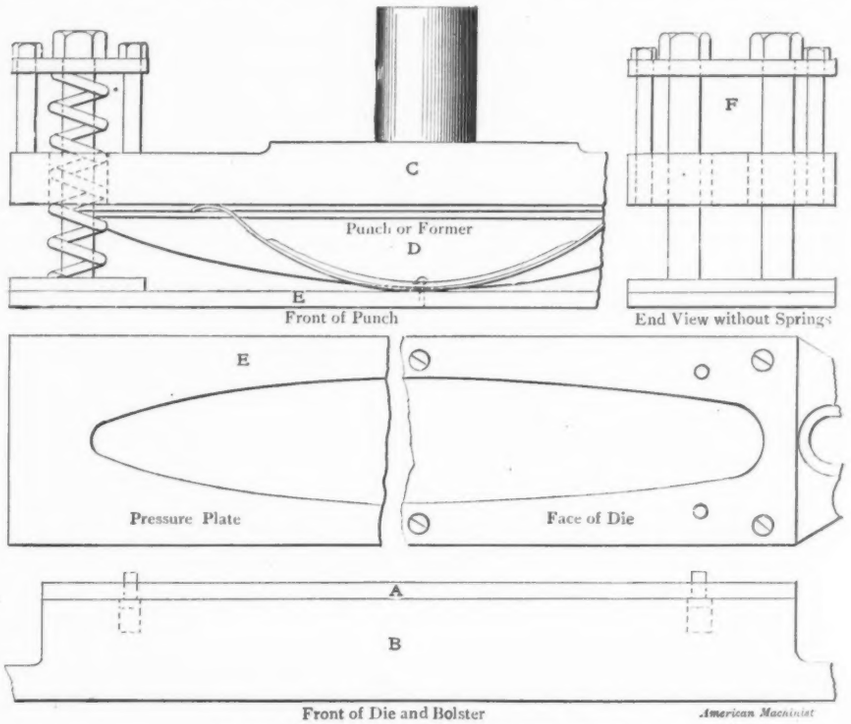
If it seems more exact and more appropriate to speak of laboratory exercises than of shop work, then let us be technically exact and more broad in our interpretation, and not confuse mere manual training school exercises with the more appropriate laboratory work of a properly equipped shop of an engineering college.

Ithaca, N. Y. C. E. COOLIDGE.

Drawing Miniature Yacht Hulls.

Editor American Machinist:

The die here shown was designed for drawing up a miniature yacht hull, and, as the only press we had for doing the work was a small diemaker's screw press, we designed the die to fit. The stock used was sheet copper about 29 Brown & Sharpe gage, and the job was long enough so that we could erect spring cages on each side of the ram slides. The only trouble we experienced was in finding the proper spring pressure to hold the wrinkles out.



DIE FOR PRESSING MINIATURE YACHT HULLS.

Referring to the sketches, *B* is a gray-iron bolster die with a steel plate *A* screwed on the top, the wear all coming on this steel plate. Gage pins *a* held up by springs and between which the stock is laid, are forced down as the punch descends. *C* is a gray-iron punch holder on the ends of which are erected the spring cages; *D* is the punch or former proper; *E* is the pressure plate. The end view *F* of the punch, with spring cages and pressure plate assembled does not show the springs. We found it necessary to mount elliptical springs on the front and back to

prevent the pressure plate from springing away from the work, also to get our pressure more evenly distributed over the surface. In operation the pressure plate first comes down on the blank and holds it as the punch descends and draws it to the required form.

In general practise the die would be made the other side up; that is, if they had a press large enough to accommodate it. As it was we had no trouble whatever in doing the work in one operation and the pieces came out nice and smooth.

BARLOW.

New Classification of High-Speed Motor Boats.

A step of considerable interest to all persons interested in small speed craft was taken on April 5, when the American Automobile Association formally assumed control of "strictly high-speed motor boat racing," under a new classification which departs entirely from that used by the American Power Boat Association. The latter organization, as is well known, employs a measurement rule under which the speed of a boat is supposed to be proportional to the cube root of the fraction formed by the product of the horse-power and the square root of the load water line, divided by the midship section. Altho very satisfactory for the cruising launches for which it was designed, when applied to boats of high power per unit displacement, this rule credits them with a speed quite a little in excess of what they can make, owing probably to the relatively much greater wetted surface of these very shallow-draft boats, as compared with ordinary cruisers.

Class	Length	Minimum W. L. Beams	Maximum H. P.
A	All boats not over 26 feet, L.W.L.	3 ft., 9 in.	30
B	All boats over 26 feet and not over 32 feet, L. W. L.	4 " 2 "	50
C	" " 32 " " 40 " "	4 " 9 "	90
D	" " 40 " " 50 " "	5 " 6 "	180
E	" " 50 " " 65 " "	6 " 6 "	400
Special A.A.A.	All boats not over 40 feet over all length of hull.	No restriction	No limitation

For this reason Lieutenant Charles H. Hall and Herbert L. Towle, acting as the motor boat committee's technical advisers, recommended the abandonment of the time-allowance feature altogether where fast boats were concerned, on the ground that these craft are still too recent for their speed to be calculable with sufficient certainty. In its place they advised a straight l. w. l. classification, with suitable requirements as to minimum beam and maximum horse-power. Under this classification, the total piston head area for all the cylinders is limited, but not the stroke or speed, the object being to encourage as much as possible the development of marine motors of high power and speed. The nominal power rating under the A. A. A. classification is based, for four-cycle engines, on an assumed mean effective pressure of 66 pounds per square inch net (after deducting internal friction losses), and on an assumed piston speed of 1,000 feet per minute, which is considered to be near the limit of practical operation. On this basis a brief calculation shows that the rated horse-power is equal to just one-half the total piston head area in square inches.

From the complete classification given below, it will be seen that if the rated horse-power is attained, the result will be a line of boats considerably more powerful than anything to which the yachting public has as yet been accustomed.

The unrestricted special class is made for the purpose of bringing out a class of boats eligible to compete for the International Challenge Cup offered by Alfred Harmsworth.

What the displacements will be in these several classes will no doubt be an interesting subject for the study of designers, tho it may safely be assumed that it will not be necessary to build monstrosities to reach the limit of power, as the technical men who devised the classification based their work throughout on data derived from actual practice.

Mr. Pole Again.

It has been some time since our readers heard anything from B. C. Pole, Esq., inventor of Poleforcia. He still lives, however, and the kind of thinking he is still doing on mechanical subjects is *clearly* indicated by this latest effusion which comes from him. He writes:

Those who manufactured the Momentum Engine, and expected it to down; that, fearful commercial swindle the Theory of Energy made a mistake because it really didn't matter what you showed, or what you demonstrated, because the demonstration would always be claimed to be; insufficient, and incomplete, in fact the statement would stand this way: "I don't care what you show by the Engine it is contrary to the Theory of Energy" and therefore nothing could be done with the Heat driven Mechanical Motion. But within a very few months of the oath:—of a supposed eminent man; that, you put so much energy into a fly-wheel to give it motion, and you take out that Energy to stop or retard it, purposely conveying the idea that something was put in and taken out of a cubic nature an infamous falsehood, and perjury when sworn to, for nothing is put into a fly-wheel, injected into it, by the mere act of giving it motion, and there is nothing extracted out of the wheel; by, the mere act of stopping or retarding it. As said before, within a few months the Scientific world were allowed to see "Radium" discover it. RADIUM has always existed as a mineral, and it comes out this way and proves exactly what I have been saying, that the untrue the Theory of Energy was paid for, and studied out, and for a purpose, it couldn't be otherwise because of RADIUM as it was then existing in the ground, the whole matter worked exactly this way: Get up a wonderful theory, preventing an investigation of motive Power, we are quite willing to pay for it, but it will never do to have the theory by itself, we've got to work up a startling Inventor and he must have an extraordinary invention, which if actually true, no man would put money in to investigate motive Power, because with the Theory of Energy and the Keely motor, there was no chance of gaining remuneration to any investment, which would go in between these two industriously worked up and paid for points, the Keely motor and the Theory of Energy.

. . . You see I have been perfectly safe in my fight against the theory of Energy, and Sir Isaac Newton wasn't as big a fool as some latter day gentlemen would have liked to make him out to be. But it is really a joke to see how some are floundering and trying to get out of the blunder, men who have put themselves up as leaders of thought, of gigantic brains are suddenly discovering that Creation is a fact and the quicker they get out of the Conservation of Energy and the Theory of Energy the better it'll be for them. Every Engineer knows that you can drive a certain steam engine, say my own, 275 revolutions a minute at a certain pressure of steam, 80 pounds, and the engines will rate a *certain Horse Power*. Now double their speed, but cut the steam pressure in half to 40 lbs and the engines are closely the same Horse Power. Not so with the great Fly-wheel making 100 revolutions a minute; here they are, ten Horse-Power, in series as we use them, but the same Fly-wheel going 200 revolutions a minute; are, 40 Horse Power in the series as we use them. I am laughing. And so are the Banks, and they are calling in their loans; because, they are not going to forget that, they might have a lot of stock, and stuff left on their hands for their loans, which would not realize 33 cents in the dollar, on these fact of the Theory of Energy proving false.

[It is perfectly safe to say that the above is unanswerable for the simple reason that it is not understandable.—Ed.]

The peculiar fracture of tungsten steel is one of its marked characteristics, and is not possessed by any other steel. The familiar way of characterizing it by the steel makers is to call it "silky." This appearance is most marked when considerable carbon, say 1.4 to 1.5 per cent., is present.

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Our Alleged Need of German Guns.

Referring to the too frequent reports of accidents happening to our naval vessels when firing their guns at target practise, a German military expert is quoted as saying things that will not be pleasant to some American ears. In effect he says that we evidently do not know how to construct and use guns, or rather, that we do not know as much about the science of artillery as is known in Germany, and that as it is manifestly unwise to place much dependence upon our own guns we might do well to order some good guns in Germany and to have Herr Krupp write on the outside of the packages in which they are shipped, *bitte eilen*, or whatever is the German equivalent for "In haste." Of course there will be plenty of Americans whose ire will be aroused by this and who will be for going right over to Hamburg and other German ports and giving these conceited Germans a practical demonstration of the ability of our naval guns to inflict more damage in front of them than within and in the immediate vicinity of the turrets in which they are mounted. This would be very rude, however, and a better plan would be to find out if possible exactly whether the Krupp guns do go wrong with anything like the frequency that our own do, and if they do not then to buy some of them and to learn how they are made. If we are to have guns we ought to have the best there are, and there is no manner of doubt that Krupp makes good ones. And this brings us again to our harmless but nevertheless interesting hobby on which it has pleased us to take a little canter occasionally since the beginning of the talk about a department of commerce and manufactures ten years or more ago—why would it not be better if all these guns and other things used by the Navy and other departments of the government were to be made by or under the supervision of a department of the government devoted to that purpose? This department might then be directed by a corps of civilian experts and engineers. The work of inspection might then be done by men trained to do that work properly and not quite so easily imposed upon as many truth-flavored rumors tell us has been the case with young naval officers whose turn has come round to be "detailed" for inspection duty. One thing the most patriotic of us must admit, and that is that it is disconcerting to have these fatal accidents happening and to find that as a result of them orders have been or may be given to reduce the service charges of guns below what they were originally designed for. It is true enough that all sorts of excuses for this can be brought forward in view of the very high stresses dealt with in modern gunnery, and the unknown quantities entering into the problem of dealing with modern, high-power, smokeless powders; but the main thing is to find out whether German guns stand up to this better than ours, and if so, why.

Report of the Mosely Educational Commission.

We have been favored with a copy of the bulky octavo pamphlet report of 400 pages which is the outcome of the commission which was sent to this country from England last year by the unique generosity of Mr. Alfred Mosely. To summarize or even to give an adequate idea of the contents of so voluminous a document within permissible limits is a most difficult task, and we shall not succeed in satisfying ourselves in the attempt. The object of the commission was to study general rather than technical educational methods, and while the latter are not neglected, the bulk of the report conforms to the main idea of Mr. Mosely in this respect.

The commission was composed of twenty-six members, each of whom writes his own report, which is, broadly speaking, devoted to some special phase of the subject, tho the line of demarkation is not in all cases a sharp one. In addition to these individual reports a brief joint report appears in which appear such leading facts as the different members agreed upon.

It should be observed at the start that a commendatory and even laudatory tone was to have been expected as a matter of course. The commission came here to find features in our educational methods which could be commended to their own people. They were looking for the best and they found it, and, having found it, they naturally report upon it, the result being, we have no doubt, more favorable than the facts justify. For example, in regard to labor conditions, to which there are several references, there is no doubt that the facts do not warrant the favorable statements made. The commission appears to have discovered the existence of the premium plan, and reports upon it as a characteristic and general peculiarity of our industrial establishments, when the fact is that that plan is as much and probably more widely used in Great Britain than here. At the same time, when so many agree upon educational features of which they are especially able to judge, there must be some foundation to their findings at least in a comparative sense, while, in those things which seem noteworthy and even strange to English educators, much may be learned of the English point of view and hence of English conditions.

Perhaps the strongest single impression made upon the members of the commission is the importance given here to education as a public matter, to its acceptance as necessary to the public welfare and upon the liberality or, as it impressed some, even prodigality with which it is supported. Thus one member, when giving the cost of the Central High School of Philadelphia, says, "Such huge figures seem almost incredible," and another says, "The expenditure of money on education is generous to the verge of extravagance." It is gratifying, too, to note the appreciation of the influence of the public schools in

assimilating our population of foreign birth or parentage. As one commissioner puts it: "The common schools are, as anyone who sees them at work can tell, a great unifying force in the life of the nation, always engaged in stamping a mass of heterogeneous elements with the hall mark of American citizenship." Even the practise of teaching patriotism through such exercises as saluting the flag, which might well impress those from abroad as a piece of jingoism, is referred to with commendation.

Perhaps the next most striking feature of these findings is the difference in the relation between teacher and pupil as compared with the condition in England. As one member puts it, the teacher is "much more a class leader than a class driver, and in no school did I observe the British tendency to regard each other as natural enemies."

The fact that pupils are willing pupils, and that in university life they often make great personal sacrifices and, in many cases, support themselves in order to obtain an education is referred to as something unknown in England. It is pointed out that such students do not suffer in social status, and one commissioner says enthusiastically, "Such students are the very salt of the earth and the nation is robust in health which rears such virile spirits."

The democratic spirit of the schools also comes in for repeated reference. One member notes that "in Washington we saw the son of the President of the United States, two grandsons of the late President Garfield and many children of members of Congress sitting and working in the same classes as the children of coachmen, gardeners, laborers, etc. Not the slightest difference is observed in regard to these children; they mix in the classes and playgrounds on terms of perfect equality."

Other features which impress these gentlemen as strange are the education of boys and girls together, the preponderance of women teachers and the comparative absence of examinations. In this last they refer to the English system of competitive examinations by an outside examining board which is repeatedly condemned outright. They recognize, of course, our system of examinations by the teachers, but also recognize its purpose—the determination of the pupil's fitness to pass from one grade to another, rather than for the purpose of ranking and classifying the pupils of the same grade—and consider it comparatively harmless.

Considerable space is given to technical education, but there is less that is quotable than in the reports dealing with general education. The reports on technical education are more largely descriptive and statistical than are the others, with fewer comparisons and conclusions. One member finds that "the technical schools of America exhibit few features which distinguish them from our own schools of the same class," altho another finds that "the numbers of day students in attendance at these technical institutions demonstrate a success beyond anything we know of in this country." Several agree that our industrial progress cannot be attributed to our educational methods. It is pointed out that technical education on a large scale is too recent a thing with us to have made it possible for such to have been the case, altho its importance for the future is recognized. One feature of technical education here which is emphasized by one member is the extent to which teachers of engineering engage in outside work. Emphasis is laid upon the fact that technical graduates find no difficulty in securing employment, that employers seek their services and that the demand for them is greater than the supply. It is pointed out, of course, that such graduates begin with modest positions and salaries, and this procedure is referred to as something that is characteristically different from what obtains in England, tho what the substitute is we are not informed.

Regarding it, as it is, a distinct American educational development, we are disappointed in the amount of space given to correspondence instruction, tho what is said is distinctively appreciative.

It must not be inferred, however, that the report is uniformly laudatory. On the contrary, we find wholesome criticism, some of which is no doubt well deserved. Thus in the joint report the committee "view somewhat with alarm the growing preponderance of women teachers." One commissioner finds that "the quality of the work is distinctly mediocre. In some respects probably the average work is better than ours, but I saw little or none that an English examiner or inspector would call good."

One member has a very low opinion of our material products, which he set himself to observe as the result in a broad way of our educational methods, saying: "Workmanship, not words, is the truest reflex of a people—by their works you shall know them." "I have not been able to find any real originality in design, in ornament, in anything where the brain, the hand and the higher emotions work together." "Most American products which are used by the million are of a much lower grade of form, color and presentment than our own." "Having been entrusted by my committee at home with some money to buy examples of American products, I had the greatest difficulty in finding pottery, glass, textiles or even printed books which could be put forward as attainments for students to see and learn from." "The general trend is to a costly and vulgar magnificence, as seen in their churches, hotels, public buildings and millionaire homes." "You see on every hand glaring examples of the obvious and blessed truth that money cannot buy everything."

While short, perhaps the most wholly commendatory note of the whole pamphlet refers to the colored schools at Hampton and Tuskegee. The author above quoted says, "No single thing in our experience was so profoundly beautiful and touching as this day at Hampton."

Reducing the Rolling of Ships.

At the recent meeting of the British Institution of Naval Architects a paper was read by Herr Otto Schlick on "The Gyroscopic Effect of Flywheels on Board Ship," which attracted much attention. Herr Schlick's proposal is to mount a heavy flywheel on a vertical shaft in the hold of a ship, the supporting frame being similar in effect to that of the toy gyroscope, in order to lengthen the time and reduce the angle of the rolling of the ship. The Bessemer Channel steamer of twenty years ago was an unsuccessful attempt to apply the same principle to a saloon which was hung on trunnions and which was to be kept level by the action of a gyroscope, and this failure was of course brought out in the discussion. According to Herr Schlick the failure was due to the ignoring of certain essential principles of gyroscopic action which were not then generally understood. Mr. Macfarlane Gray predicted the failure of the Bessemer gyroscope before it was tried, having, in fact, pointed out the principle to which Herr Schlick now calls renewed attention. Calculations have been made to determine the necessary weight of flywheel, and Herr Schlick concludes that in a vessel of 6,000 metric (5,905.5 English) tons a flywheel of 4 meters (15.12 feet) diameter and weighing 10 metric (9.842 English) tons would have a marked effect.

On Tuesday and Wednesday, May 10 and 11, Mr. Charles S. Howe will be inaugurated President of the Case School of Applied Science, Cleveland, O. The inauguration exercises will consist of an address by Dr. Worcester R. Warner, representing the Board of Trustees, following which will be addresses by President James B. Angell, President Henry S. Pritchett, John R. Freeman and President Charles F. Thwing, after which President Howe will deliver his inaugural address. There will be an informal luncheon and a banquet at the Hollenden.

Our American electrical contemporaries will have to hustle. Here is *The Electrical Magazine*, published in London and edited by Theo. Feilden, out with its second number (count them) and claiming, in large, green letters across the top of the cover, "Largest circulation in the world." This utterly puts to shame the best claims of some of our most claimful American contemporaries not electrical, also. Dear knows they have been ready enough to claim everything in sight, but none of them, so far as we can remember, has ever dared to think of such

a thing as claiming to dominate the whole field before its second edition was off the press.

We have read with interest and profit the first of a series of letters relating to municipal engineering in Europe by Mr. M. N. Baker of the editorial staff of *Engineering News*. Mr. Baker has been for more than a dozen years in editorial charge of matters of municipal engineering and sanitation, and he is now to spend several months in the investigation of European practise. The idea is an excellent one. There is undoubtedly much to be learned on each side of the Atlantic by an open-minded observation of established practise on the other side, and in no department have we more to learn from our friends across the water than in the building of our cities and in the arrangement of the facilities which cities provide, so that all will be secured the best conditions for health and contented activity. The first letter of the series carries with it the fullest assurance of high ability to discover and to tell the precise things which it will be well for us to be informed of and by which we may be stimulated to look for and to insist upon more satisfactory adjustment of the multifarious arrangements of urban and suburban life.

Union Engineering Building.

In order to enable the three national engineering societies to avail themselves of Mr. Carnegie's gift of a building for headquarters and library purposes, etc., the conference committee has had drafted a bill incorporating what is known as the United Engineering Society to hold the property for the societies. The bill is virtually a transcription of the act incorporating the Cooper Union, the purposes being in most respects identical with regard to the public objects of the building.

The conference committee has also selected the following well-known firms of architects who have consented to join in a limited competition for the plans of the building, as well as of the Engineers' Club, namely, Carrere & Hastings, Clinton & Russell, Whitfield & King, Ackerman & Partridge, Palmer & Hornbostel and Lord & Hewlett. The committee also expects to provide itself with a professional adviser whose assistance it will enjoy in connection with the architectural part of its work. In addition to the six competing firms, each of whom will be paid for its plans, there will be an open competition in which the leading competitors will be compensated by four prizes. It is believed that this mixed competition will furnish the committee with a wide range of desirable things. Some of the best firms of architects do not enter these competitions, but it was Mr. Carnegie's wish that the matter should be put on this broad basis.

Some bolts on London bridges have been found to have rusted away in twenty-five years from ⅞ to 1½ inch in diameter.

Some New Things.

AN EXPANDING MANDREL FOR LOCOMOTIVE ECCENTRICS.

The half-tones show the construction and the application of an expanding mandrel specially designed for turning locomotive eccentrics. The body of the mandrel, Fig. 1, is a straight cylindrical piece considerably smaller in diameter than the hole in the eccentric, with the driving end, at the left in Fig. 1, enlarged sufficiently to give room for a good sized center upon which the eccentric is to be turned. A cap is fastened on to the other end of the mandrel by two cap-screws, the outside diameter of this cap as large as may be necessary but not larger than the hole in the eccentric. This cap is secured from turning on the mandrel by a suitable feather. A center is made in the cap exactly opposite and corresponding to the eccentric center in the driving end. Upon the parallel body of the mandrel slides a plain sleeve the outside diameter of which is smaller than the hole in the eccentric. This sleeve has four equidistant slots through it, and through these slots project the jaws which carry the eccentric. The jaws bottom in tapering grooves in the mandrel and have lips which prevent them from dropping out of the sleeve. On the outside of each jaw toward the driving end of the mandrel is a lip which prevents the eccentric from slipping over. One of the jaws in line with the eccentric centers has a raised strip which fits the keyseat in the eccentric and locates it circumferentially. To put the eccentric on the mandrel it is laid flat upon a block which has an opening sufficient to clear the mandrel, and the mandrel, held preferably by an air hoist, is lowered into the eccentric, and if allowed a free drop of five or six inches the eccentric is fastened securely for the turning operations. When the eccentric is finished it is as easily taken off by a reversal of the process. The mandrel has been in practical use and has proved its efficiency. It is known as the Nicholson eccentric-turning, expanding mandrel, and is made by W. H. Nicholson & Co., Wilkesbarre, Pa.

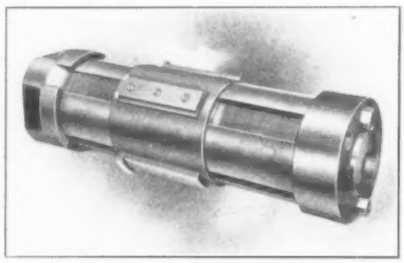


FIG. 1. EXPANDING MANDRELS FOR LOCOMOTIVE ECCENTRICS.

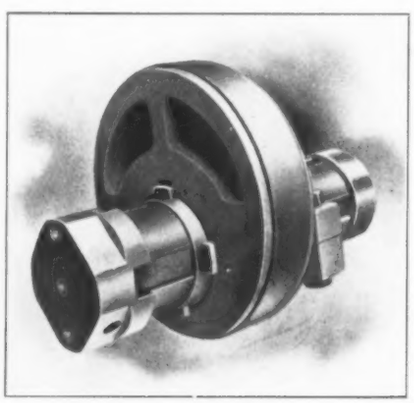
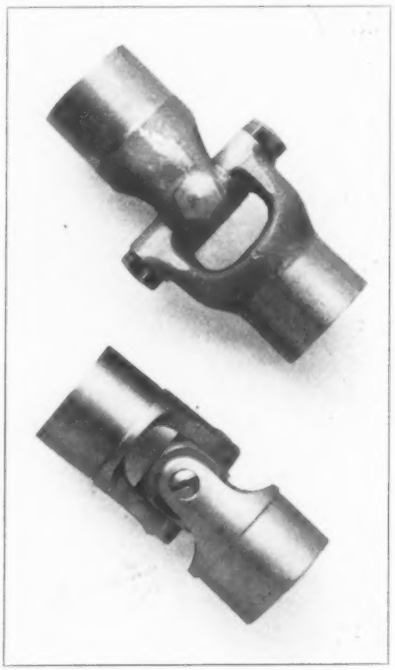


FIG. 2. THE ECCENTRIC ON THE MANDREL.

UNIVERSAL JOINTS FOR SHAFTING.

The half-tone shows two styles of universal joints now being manufactured by the Boston Gear Works, Boston, Mass. They are suggested as specially desirable for automobiles and for various machine tools, such as millers, shapers, etc. The bronze coupling, shown at the top, has hardened studs which are fastened in the center and turn in the jaws, thus giving a long bearing in each, the wearing surfaces being of different metals. The lubrication of the bearings is properly provided for. This coupling is made in various sizes for shafts from ¾ inch to 2 inches diameter, and the hubs are bored ready for fitting the shafts. This coupling will work to any angle of 25 degrees or less.



UNIVERSAL JOINTS FOR SHAFTING.

In the all-steel coupling, shown at the bottom, the pins are fast in the jaws and have taper fits in the central block, both block and pins being hardened. One of the pins has a screw plug for oiling, the oil being retained in the center of the block and supplying all the pins. This coupling will work up to angles of 40 degrees; the hubs are not bored unless so ordered. The hub diameters run from ¼

inch up to 2½ inches. The couplings are accurately fitted and show excellent workmanship.

A NEW VARIABLE-SPEED MOTOR.

The accompanying illustrations relate to a new line of single-voltage variable-speed motors which has been brought out by the Commercial Electric Company, of Indianapolis, Ind.

The special feature of the motor is the combination of two armature windings and two commutators which are used together or separately, as required, and thus give three base speeds to each of which the range obtained by the usual method of field control is added. The two windings are of the same size wire, and hence have the same ampere capacity, but the number of turns varies, the ratio being usually that of two to three. When both windings are used a speed corresponding to five turns is obtained and with the two and three turn windings used above corresponding speeds are obtained, the ratios of these speeds being 1 to 1⅔ and 1 to 2½, respectively. To the two lower of these speeds the field control adds a range of about 40 per cent. and to the highest it adds 60 per cent., giving a total range of 1 to 4, while the horse-power capacity and the efficiency at full load are practically constant at all speeds. These speeds are obtained in twelve steps which are uniformly graded and do not overlap.

Fig. 1 is an illustration of the motor and Fig. 2 shows the controller. Of this latter the handle at the right of the top is for starting, stopping and reversing the motor while the one at the left controls the speed. Fig. 3 gives the results of an efficiency test of a 5 horse-power motor and Fig. 4 shows the degree of regulation at the various speeds and loads.

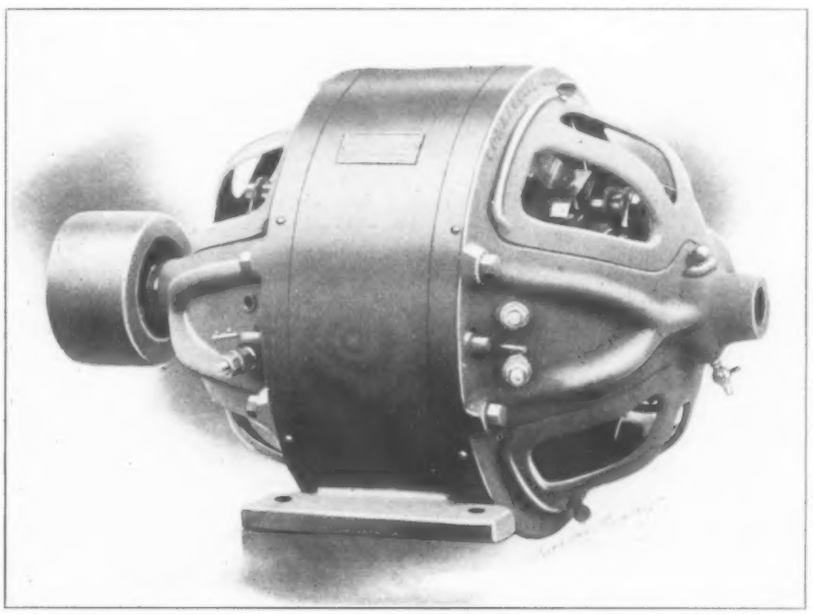


FIG. 1. SINGLE-VOLTAGE VARIABLE-SPEED MOTOR.

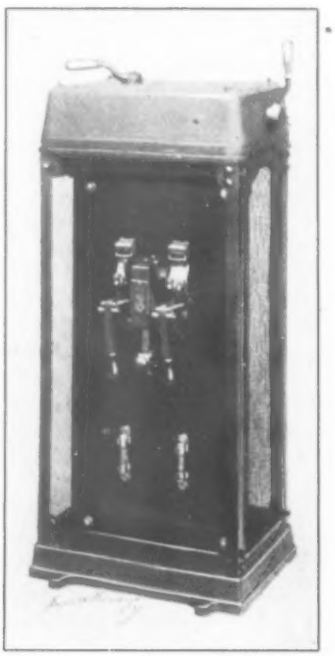


FIG. 2. CONTROLLER FOR VARIABLE-SPEED MOTOR.

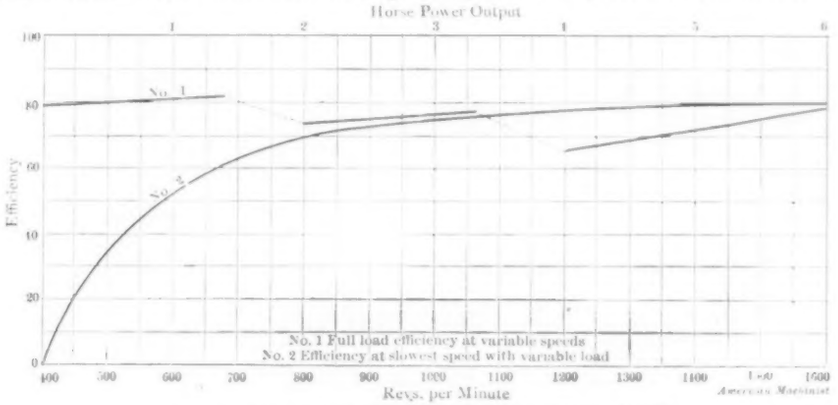


FIG. 3. EFFICIENCY TEST OF A 5 HORSE-POWER MOTOR.

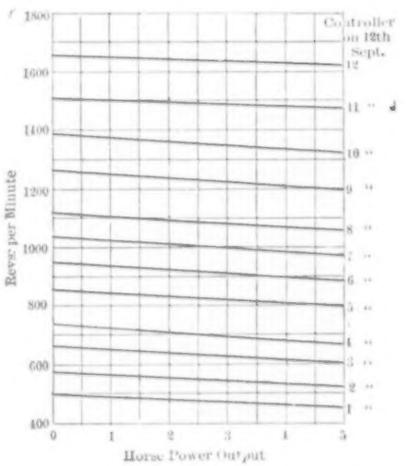


FIG. 4. REGULATION AT VARIOUS SPEEDS AND LOADS.

The Steam Turbine in the Navy Yards.

A Westinghouse-Parsons turbine generating unit is in process of construction at the Charlestown Navy Yard, Boston, Mass. The current is to be used for pumping the old and new drydocks and also to supply light and power to the buildings, as well as light and power to vessels docking but which do not happen to be under steam. The plant is to be of 750 kilowatts capacity, and will operate condensing under steam of 150 pounds pressure and 100 degrees superheat.

The Summer School of the State College of Kentucky.

The above-named institution at Lexington, Ky., will open its summer school June 8, the length of the term being ten weeks. The work offered includes courses in steam engineering, applied electricity, machine design, materials of construction and transmission of power and shop work. The fee for each course is $25. Reduced rates for transportation have been obtained from all railroads in Kentucky and within the capacity of the dormitories no charge will be made for room rent. No entrance examinations are required. For further particulars address John T. Faig, M. E., Registrar, Lexington, Ky.

For the Regulation of German Patent Attorneys

The following extract from the new rules of the President of the Imperial Patent Office of December 23, 1903, in connection with the law *regulating* (that is the proper term) patent attorneys dated May 21, 1900, may be of interest, not only in Germany, but here as well. It has been translated for us by Henry Hess:

In securing clients it is considered improper and not in accordance with the professional duties of a patent attorney to

1. Send out circulars, prospectuses, tariffs of charges, or to offer services to the holders of patents listed in the official publications.

2. Calling attention of persons with whom the attorney is not already in professional connection to the official provisional advertisements of patent applications and the simultaneous offer to procure extracts or to enter objections.

3. The too striking arrangement of printed matter or bragging advertisement of one's own manner of conducting business or making charges, such as "prompt," "cheap," "personal attention," etc.

4. Offering advice and information to clients free of charge, either in general or to the subscribers to a certain publication.

5. The publication in the editorial part of newspapers or magazines of statistical information, compilations or lists of inventions taken from the official publications.

In this connection it may not be uninteresting to note in view of the advertisements issued by a great many of our traveling physicians that in Germany it has been decided not in accord with the dignity of a physician to put up two signs on his house.

A bill has been hanging fire in the House for some time which has for its object the reimbursement of the Heppenstall Forge & Knife Company, of Pittsburg, for a lost check to the amount of $3,048.50. This check was issued in payment for drop hammers and other machinery furnished the Rock Island Arsenal by the above-named company, when it was doing business under the former firm name of "The Pittsburg Shear, Knife and Machine Company" and which check was lost through the mails after it had reached the company, and was being sent by them to the bank. The letter in which it was enclosed was received by the bank, but the check was missing. The government was promptly notified and payment on the check was stopped. It appears that under existing laws it is only possible for the government to issue a duplicate check for an amount not in excess of $2,500, and it appears that the only way in which the company may get its final payment of account for the amount named is by the passage of the measure referred to.

Technical Publications.

The Chicago Pneumatic Tool Company issues what it calls a monthly magazine, which is entitled "Something Pneumatic." It is devoted entirely to things that have to do with compressed air and compressed air machinery, and is, we understand, to be sent gratuitously to anyone interested.

A new technical journal known as *Concrete* has made its appearance. It is published by the Concrete Publishing Company, Detroit, Mich., and is to be devoted to the interests of those who have to do with the construction of concrete buildings, bridges, walls, etc.—a growing industry and one which promises to be very important.

We are favored with a copy of "Bulletin No. 27" of the American Chamber of Commerce of Paris, the first portion of which is taken up by a review of a paper entitled "The Metric System in Relation to the Shipbuilding Industry of the United States." The paper was presented by Naval Constructor J. H. Linnard, U. S. N., and the review of it for the American Chamber of Commerce is by Blythe W. Branch, member.

We have received the "third delivery" or section of a work on water-tube boilers ("Die Wasserrohrkessel) for war and merchant ships, their construction, operation, management and service, by Walter Leps, and since his death continued by Max Dietrich. It is published by C. J. E. Volckmann, of Rostock, Germany. There are to be four or five sections in all, and we understand that the price of each (whose acceptance implies a subscription for the whole work) is 1.50 marks.

"X-Rays Simply Explained." By R. P. Howgrave-Graham. 93 5x7-inch pages with 6 full-page plates and 10 text cuts. Percival Marshall & Co., London. Price sixpence.

Much has been written on the X-rays, and of all grades of profundity, but we have seen nothing which will appeal to more readers than this unpretentious pamphlet. It is an explanation of the little that is really known of the obscure phenomena of the X-rays and of their experimental production and forms, in fact, an excellent illustration of simple yet truly scientific language. Beginners in X-ray work can do no better than obtain a copy.

"Electricity and Matter." By J. J. Thompson. 162 5¼x8-inch pages with 22 illustrations. Charles Scribner's Sons, New York. Price, $1.25.

Yale University has come into possession of the legacy bequeathed to it for the foundation of a course of lectures in honor of Mrs. Hepsa Ely Silliman, and the present volume contains the first of this series of lectures. It is a statement by one of the most renowned of living authorities of the most advanced views of the ultimate constitution and relationships of matter and electricity and contains perhaps more of profound significance in this, the ultimate field of research, than has appeared within the same compass. Among physicists the book cannot fail to be widely read.

"Electrical Engineering Experiments and Tests on Direct-Current Machinery." By George F. Sever. 64 5½x8½-inch pages, with 22 illustrations and 13 blank forms. The D. Van Nostrand Company, New York. Price $1.

Prepared primarily for those engineering students of Columbia University who do not make a specialty of electrical engineering, this volume is also well adapted to the needs of engineers other than electrical who possess familiarity with electrical machinery and apparatus, and who desire to familiarize themselves with the methods of testing such machinery. A series of experiments is laid out and described with the aid of wiring diagrams, forms of log books for entering the observations and instructions and cautions regarding the conduct of the experiments. The book is but mildly mathematical and should be useful to many.

"Non-Corrosive Nickel Steel Boiler Tubes." By Albert Ladd Colby. 28 8x11-inch pages with 4 full-page plates. Abstracted from the Proceedings of the Society of Naval Architects and Marine Engineers.

Boiler tubes of nickel steel were first made abroad in 1898, and their manufacture has now been undertaken in this country. Tests have shown them to be more durable than carbon steel tubes in the ratio of 2⅓ to 1, while their increased strength and non-corrosive properties permit the adoption of lighter gages, with a consequent reduction in weight, which for marine purposes is of obvious importance, while it partly offsets the increased cost per pound. The paper under notice describes briefly the foreign and American methods of manufacture, shows the saving in weight in particular cases, gives figures regarding the present cost of the tubes and the results of tests upon their non-corrosive and mechanical properties.

"On the Practical Application of the Results of the Manchester Experiments with Rapid Cutting Tool Steels." By C. Finch Hatton. 31 5½x8½-inch pages with 4 text cuts and 1 folded diagram. Published by the author, London.

The Manchester experiments, of which we published a report by Prof. Nicholson at pages 1620 and 1658, Vol. 26, supply a large field for study and analysis, which the author of this pamphlet has made. The leading result of this study is a large diagram whereon are plotted the areas of the cut and the weights of metal removed in combination with curves for the grades of steel tested, and by the use of which the quantity of metal removed under different

cuts can be quickly determined and compared. The pamphlet is a striking illustration of the new phase of machine-shop economics which was entered upon with the advent of high-speed steel, and obviously the end is not yet. There can be no doubt that this steel is to be the mainspring of the greatest development in machine building of this generation.

"Compendium of Drawing." Two volumes, 6½x9½-inch pages. Compiled from the instruction papers of the American School of Correspondence at the Armour Institute of Technology, Chicago. Price, until June 1, $3 per volume, $5 per set.

Of these volumes the first covers geometrical drawing, including projections, intersections, shades and shadows, perspective, pen and ink rendering and architectural lettering, while the second takes up working drawings, mechanism, machine design and sheet metal pattern drawing. The names of eight different authors appear upon the title pages. The papers by Mr. C. L. Griffin on "Working Drawings" and "Machine Design," which have been favorably reviewed in these columns, are included and, without making invidious comparisons, for all the parts are good, we may mention as especially good and thoroughly practical, the paper on "Sheet Metal Pattern Drafting," by William Neubecker, instructor in the sheet metal department of the New York Trade School.

Frank Kempsmith.

The death of Frank Kempsmith, of Milwaukee, which, as noted last week, occurred April 10, comes to the editor of this journal as a personal affliction. To have known him intimately and for many years and to have been a shop mate of his was a rare privilege. Kempsmith was the kind of man of whom the world never can have enough; quiet, unassuming, clean-minded, honorable and true, he played life's game to the end through all manner of vicissitudes, bearing manfully the most trying bereavements and in the end grimly facing a death which for years he knew to be inevitable. The cause of death was sarcoma, on account of which one of his eyes had to be removed some years ago. At thirteen years of age he began his mechanical career, and as a workman at the bench gained an enviable standing as a highly skilled machinist and toolmaker. He worked in various Eastern shops, including Garvin's, in New York, and Brown & Sharpe's, being noted for his high skill, good judgment and conscientious work. Finally he went West and was for a time a toolmaker in Springfield, Ohio. Afterward he became superintendent of the shops of Warner & Swasey at Cleveland, the Lick telescope being constructed there during that time. From there he returned to Springfield, and with two partners started in business building machine tools and sixteen years ago moved to Milwaukee, where by himself he built up the business now known as the Kempsmith Manufacturing Company, originating the milling machines which are known by his name. His shop was a good one; he took great pride in it, and every piece of work turned out of it had to be up to his high standard of workmanship. A young son who was especially dear to him and upon whom his hopes were largely centered fell a victim to Milwaukee's railway grade crossings, and about the same time the malady of which we have spoken manifested itself. Broken in spirit, he sold out his business and retired. Afterward and for a time he seemed better, gained hope and expressed a desire to be back at work again, but for some time past his health had been again declining. At the time of his death he was nearly fifty-six years old. He leaves a wife and one son.

FRANK KEMPSMITH.

Personal.

W. F. Warden, of the Burt Manufacturing Company, Akron, Ohio, sailed for Europe, April 15, on a business trip.

P. E. Montanus, of the Springfield Machine Tool Company and secretary of the Machine Tool Builders' Association, has been nominated for Congress on the Democratic ticket for Seventh Ohio Congressional District.

Obituary.

O. S. Kelly, of Springfield, Ohio, died there April 11, aged eighty-two years. He was for a long time prominently identified with the manufacture of agricultural machinery, and in that line built up a fortune, the foundation of which was laid in California during the "gold fever" period.

James R. Livingstone, who was found unconscious in a hotel in this city early in March, and who died of paralysis of the brain without regaining consciousness, had been for twelve years superintendent of the Ice & Cold Machine Company, St. Louis, Mo. Before that he had been with the Smith, Beggs & Rankin Company, of St. Louis, and its predecessors, pioneers in the Corliss engine business west of the Mississippi, for twenty-one years and in the business he had risen to be superintendent. Mr. Livingstone was forty-seven years old and was the son of Peter Livingstone, a noted sculptor.

Meinrad Rumely, founder of the M. Rumely Company, Laporte, Ind., died March 31, eighty-one years old. Mr. Rumely was a native of Germany and came to this country when twenty-five years old to join a brother who was making pumps at Canton, Ohio. Having learned the machinist trade he had a varied experience in different cities from Pittsburg to Chicago. He located in Laporte in 1853, and with another brother later opened a machine and repair shop. The manufacture of horse-powers and cane crushers was taken up and then threshing machines, and the business grew to large proportions. The foundry of this concern made the castings for what is now the Lake Shore & Michigan Southern Railroad.

Prof. Robert Sample Miller, of Purdue University, who died March 27 in his twenty-eighth year, had begun a most promising career, and his untimely death is much regretted. He entered at Purdue as a Senior preparatory student when but fourteen and graduated at nineteen. He entered then as a graduate student and took the degree of M. E. with the class of '97. A year and a half later he was made Assistant Professor of Machine Design, and three years ago was promoted to Associate Professor in the same line. He had accepted an appointment as Professor of Mechanical Engineering in the University of Colorado, but was not able to assume the duties of the position. He was a Junior Member of the American Society of Mechanical Engineers.

Business Items.

The Tabor Manufacturing Company, of Philadelphia, has opened a branch office at Room 84, Mason Building, 70 Kilby street, Boston, Mass., in charge of Mr. C. S. Lovell.

The Wilmarth & Morman Company, Grand Rapids, Mich., reports recent shipments of thirty-six Yankee drill grinders. Nine of these grinders go to England and Scotland; seven, including four motor-driven, to South America.

The West End Manufacturing Company, 14 Church street, New York, has been organized for the purpose of manufacturing castings, of open hearth steel, graphitic steel, electric steel, gray iron and malleable iron. The company's specialties will be small steel castings and steel fittings for high pressure steam, etc. It will make a feature of quick delivery, and says it is prepared to turn out castings in three days.

In line with its present policy of improvement, the New Haven Manufacturing Com-

pany, New Haven, Conn., has had Dodge & Day go over its entire equipment with a view of bringing it up to date in every respect. Complete interior rearrangement of the shops is contemplated, and it is probable a number of the old machine tools will be replaced by modern apparatus. Dodge & Day have also been commissioned by the Meadville Vise Company, Meadville, Pa., to redesign a number of its machine tools.

A doubling of its capital stock, which has been $1,000,000, is announced by Crocker-Wheeler Company, manufacturer and electrical engineer, of Ampere, N. J. The company was organized in 1892 by Dr. Schuyler Skaats Wheeler and Prof. Francis B. Crocker, on a relatively modest basis. It now has fifteen branch offices from Boston to San Francisco and does one of the largest businesses in the world in electric power apparatus. The capitalization was several times increased, until in 1899 it had become $1,000,000. In view of the rapidly expanding business, the stockholders have now decided to increase this amount to $2,000,000.

The Hyatt Roller Bearing Company, of Harrison, N. J., has opened a branch office at 1104 People's Bank Building, Pittsburg, Pa., in charge of Mr. John R. Graves. Some of the largest concerns in Pittsburg have been using the Hyatt bearings for some years. One of the first large orders obtained by the Pittsburg office was the equipment of thirty ingot cars, about the largest cars that have ever been built. They are for the Lackawanna Steel Company, of Buffalo, and are built to carry a maximum load of 200,000 pounds each. This will give a good illustration of the wide range of applicability of Hyatt bearings. The bearings furnished for these trucks, of which there are eight to each, are guaranteed to carry 25,000 pounds and to last for four years.

Manufacturers.

Fire has damaged Neidinger's machine shop, 110 Mill street, Rochester, N. Y.

The Wishart Manufacturing Company proposes to build a foundry at Pasadena, Cal.

The Pittsburg Lumber Company, Wilmington, N. C., has lost by fire a large plant near there.

Fire has somewhat damaged a plant of the United States Heater Company at Detroit, Mich.

The Indiana Union Traction Company, Anderson, Ind., contemplates building repair shops.

The Standard Connecting Rod Company, of Beaver Falls, Pa., has bought land for an addition.

Wm. C. Delkamp, of Oneonta, N. Y., is establishing a book-binding plant at Schenectady, the machinery to be driven by electricity.

The Crown Cork & Seal Company, Baltimore, Md., is erecting, or about to erect, a building.

Cobb & Drew, manufacturers of rivets, bolts, etc., are erecting a new factory building at Rock Falls, Ill.

The United States Standard Voting Machine Company proposes to enlarge its plant at Jamestown, N. Y.

Work has commenced on the erection of a new building for the Eureka Machine Company, Havernill, Mass.

The Northern Pacific Railway Company proposes to build a new roundhouse and car shops in Helena, Mont.

Jacques Kahn, plate glass and mirror manufacturer, New York city, has awarded a contract for a large building.

It is stated at Detroit, Mich., that the American Arithmometer, St. Louis, Mo., will establish a plant at that place.

Fire has damaged smelting works at Howard Station of the St. Louis Smelting & Refining Company, St. Louis, Mo.

The Warwood Tool Company, Wheeling, W. Va., proposes to build a new 60x450-foot plant near Glennova, in that district.

A large flour mill at Miners Falls, Pa., of the Miner-Hilliard Milling Company, of Wilkesbarre and elsewhere, has been burned.

The Palma Shoe Company, which will establish a factory at Waupun, Wis., has been incorporated with a capital stock of $50,000.

Wm. Hjorth & Co., Jamestown, N. Y., manufacturers of wrenches, etc., are to have a new factory building, 45x110 feet, two stories.

The Carborundum Company, Niagara Falls, N. Y., is starting up extensive additions recently made to its plant, and is planning for others.

The Ravine woolen mill at or near Hampden, Mass., owned by the Phoenix Spinning Company, of Providence, Rhode Island, has been burned.

J. W. Smith and E. P. Elliott, of Chanute, Kan., have been looking for a location to manufacture brick, and Wellington thinks it may secure them.

The Dalton-Clark Stave Company, which has plants at Winnfield and Spaulding, La., is to establish another factory at Monroe to employ fifty men.

The Merchants' Association, Anderson, Ind., has secured for that place the Neely-Ralya Cutlery Company, which is said now to be at Greenville, O.

Contracts are understood to have been signed for the removal of the Edwards Railroad Electric Light Company from Cincinnati, O., to La Porte, Ind.

D. M. Lefever, of Syracuse, N. Y., maker of guns, has visited Toledo, O., and negotiations have been begun whereby his plant may be moved to that city.

The Texas & Pacific has let the contract for the rebuilding of a roundhouse and shop buildings at Toyah, Tex., to replace those recently destroyed by fire.

Bausch & Lomb Optical Company, Rochester, N. Y., will erect an office and factory building, 40x470 feet in general dimensions, three stories and basement.

Wm. R. Down, of 1050 Penn street, Reading, Pa., is about to establish a plant at 735 North Tenth street, for the manufacture of patent "Composite" twist drills.

The Shirley (Ind.) Commercial Club has closed a deal with the Columbia Creosoting Company for the location of its plant at Shirley. This will employ 150 men.

The J. G. Brill Company, car builder, Philadelphia, contemplates alterations and additions to its works. Permits have lately been obtained to construct a chipping shop, etc.

A five-story building at 192 Michigan street, Chicago, occupied by the White Manufacturing Company, gasoline appliances, etc., and Faunt Bros., brass works, has been burned.

The Mississippi A. and M. College, Post Office, Agricultural College, Miss., has asked for plans and specifications for an engineering building, a power-house and other structures.

The stockholders of the Clarksville (Tenn.) Button Works have met at T. E. McReynolds' furniture store to receive the report of the committee appointed to select a site for the factory.

The Pittsburg Steel Company, of Pittsburg and Monessen, Pa., has bought 12 acres at the latter place, as a site for a seamless tube mill, which is expected to be in operation by May 15.

The Progressive Union, Columbus, Miss., has accepted a proposition of the Kavanaugh Manufacturing Company, of Cohoes, N. Y., thus obtaining for Columbus a $150,000 knitting mill.

Straker & Freeman, North Attleboro, Mass., jewelers' forgings, die cutters, etc., have bought land adjoining their factory, and it is supposed that they did this with the idea of an extension.

The Angola (Ind.) Furnace Company is negotiating with the Commercial Club and the Commercial Land & Improvement Company, Fort Wayne, Ind., for the removal of the factory to that city.

The Board of Trade of Apollo, Pa., has accepted the offer of W. H. Graham to locate a barrel factory there. The concern will be known as the Apollo Cooperage Company, capitalized at $25,000.

The Vitrified Wheel Company, Westfield, Mass., plans for a factory building, 140x40 feet, with L 45x40 feet. Power will be secured from the new electric power plant to be installed by the town.

The Union Metallic Cartridge Company, of Bridgeport, Conn., is about to build a power-house, 90x111 feet. A [steam?] turbine equipment capable of generating 3,000 horse-power will be installed and a heavy traveling crane.

The Youngstown (O.) Bronze Company will erect a machine shop in connection with its present plant. It is the intention to put up a building, 80x100 feet, containing a 40-ton electric crane and other modern equipments.

The Delaware, Lackawanna & Western, it is said, proposes to build car shops at Secaucus, N. J. There is a prophecy that within a few years the road will build machine shops on South Washington avenue, Scranton, Pa.

F. V. Curran, of Marion, Ind., is interested in the Taylor Manufacturing Company, which will locate a factory at Benton Harbor, Mich. He is also interested in the manufacture of a sugar scoop which weighs its own contents.

Downie-Wright Manufacturing Company, York, Neb., is preparing plans for a new foundry, to be equipped with all modern improvements, such as air hoists, pneumatic rammers and chippers, sand shifters and other labor-saving devices.

The J. E. Whitacre Manufacturing Company, Sycamore, Ill., proposes to move its shops to Rockford, where it has secured large buildings with water power. The company makes, we understand, metal goods, such as hinges and galvanized pipe elbows.

It is now said that the new Mancha Show Case Company has arranged to locate its plant at Detroit, Mich. The president is Raymond Mancha; secretary and treasurer, Carl N. Adams. Mr. Mancha and Mr. Adams will remove to Detroit from Grand Rapids.

The T. R. Almond Manufacturing Company, of Brooklyn, N. Y., has been incorporated under New York laws. The capital stock is $65,000 and the directors for the first year are T. R. Almond *et al.* This is evidently the incorporation of the well-known chuck manufacturing concern.

The plant of the Cadillac Automobile Company was partially destroyed by fire on April 13. The machine, carpenter, pattern and woodworkers' shops were only damaged by water, and are running again. The office records, drawings and furniture were saved. The warehouse for finished product and engines was not injured. Frame, assembling and paint departments and the stockroom for parts are totally destroyed. Work was resumed as soon as the fire was under control, and other quarters were rented, so that all departments would be running by April 18.

Facing Pipe Flanges in the Field—An Improvised But Very Efficient Lathe.

BY E. L. MILLS.

Many of the readers of the AMERICAN MACHINIST have been much interested by the "Echoes from the Oil Country" with the hurry repair work, done under difficulties and often with little to do with except the know-how, and perhaps an "echo" of a city job which for all practical purposes might have happened in the woods will prove interesting.

A pneumatic system for pumping out three shafts and the connecting tunnel of the New York aqueduct was to be installed. The apparatus was designed to go into one of the shafts which had been fitted with two sets of guides for a bailing system of pumping such as is used in mines. There was 300 odd feet of water in the shaft at its ordinary level when not pumped. The quantity of water made at the lower levels was so great that it was impossible to keep the shaft dry with any temporary apparatus while the permanent plant was being installed. It therefore became necessary to lower the two sets of tanks forming part of the plant with their valves, fittings, air and discharge pipes through the 334 feet of water to the bottom of the shaft. Owing to the conditions surrounding the work our apparatus had to be divided into two parts which involved two discharge pipes each of 15 inches diameter.

The job I am to describe is the facing of the flanges on the thirty-four pieces of pipe which went to make up the two discharge lines. The pipe was known as standard mine pump column pipe and was ⅜ inch thick, with heavy gray-iron flanges shrunk on, and the pipe hammered over into a recess in the flange. Through a misunderstanding the flanges were not faced off after this was done, and a ridge stood up as shown in Fig. 1 at *a* ranging from 1-32 to ⅛ inch high. More than that some of the flanges were out of square as much as ¼ inch. The necessity of holding the pipe in the existing guides as it was lowered and the impossibility of getting at it if a leak occurred in one of the joints

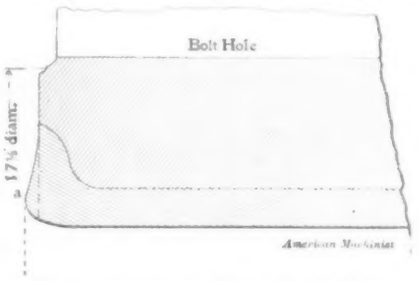


FIG. 1. SECTION OF PIPE AND FLANGES.

decided us to use a special paper gasket 1-32 inch thick, which involved true flanges.

The nearest two shops having a suitable lathe were too busy to touch the work and the nearest available shop involved a haul on a truck of about 7 miles each way, which at city prices meant about $100 to start with, and after the pipes got there the facilities were mighty poor—small shop, lathe barely capable of swinging the job and in a crowded place, no crane, and finally about the easiest way to turn the sections end for end would be to take them out of the shop and do it. Not an inviting prospect, was it?

The pieces were of random length, ranging from 12 feet to 19 feet 6 inches, and it was decided that the work could be done on the ground and save money. We had a 7x7-inch engine, two pieces of heavy 10-inch I-beam 20 feet long, and several pieces of cut granite from an old foundation 3 or 4 feet square by 10 inches thick. We started by leveling four of the stones on the ground, two at each end of the I-beams. The beams *a*, Fig. 2, were held to the stones *b* by long eyebolts *c* which passed through the base of the V-blocks *d* down between the stones and through plates *e* below the stones, thus tying and anchoring all together. The complete rig is shown in Fig. 3, which includes a 4-inch boring bar about 6 feet long having a facing head on one end and a pair of bevel gears giving a 2 to 1 reduction in the middle, all of these latter parts having been secured from the shop. Two flat pillow-blocks or shaft boxes were let into two pieces of 12x12 timber, and provision was made for wedges at each end of the boxes. Into these the bar was set, lined up and babbitted. A piece of 3-inch plank spiked to the end of the 12x12 timbers carried the outboard bearing of the pinion shaft on which there was a 24-inch pulley. The engine was bolted to two heavy planks and, after lining up, stones were piled on the planks and a 6-inch pulley on the engine shaft completed the drive.

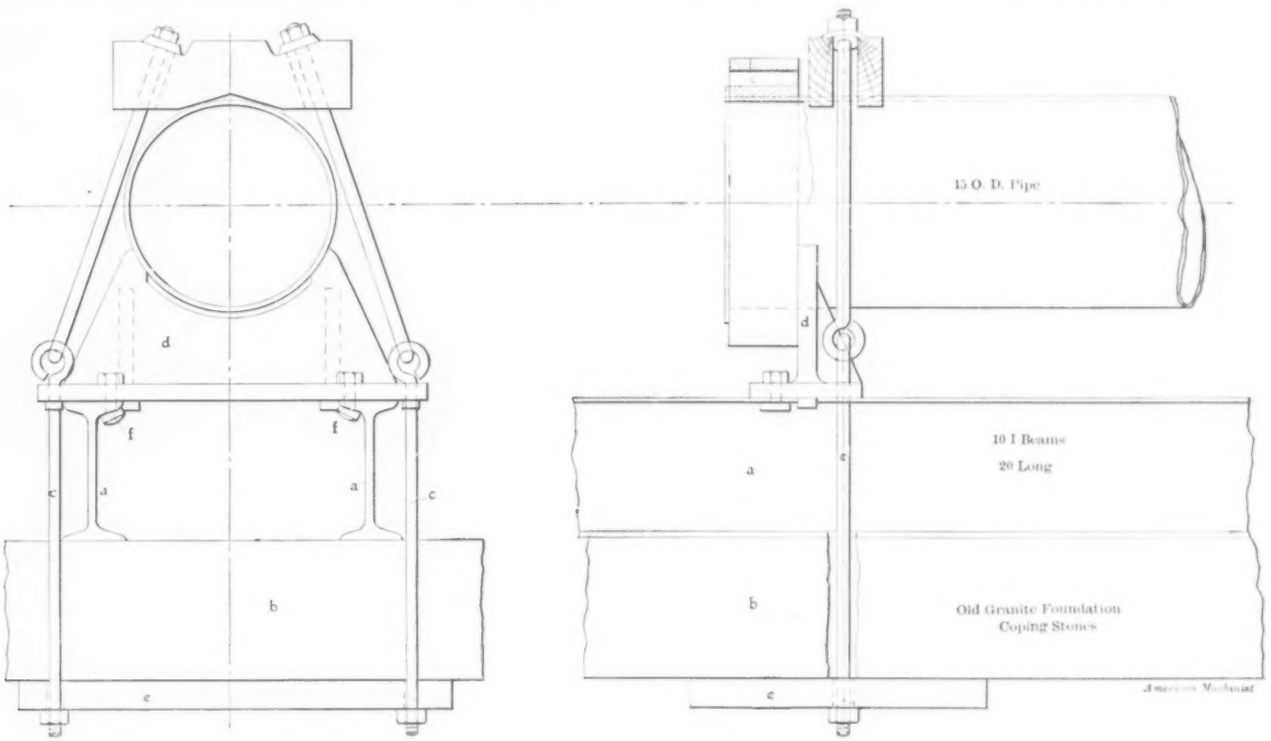


FIG. 2. DETAILS OF PIPE FACING RIG.

The V-blocks were really made to practically give a three-point bearing for the pipe, two on the block below and one in the wooden clamp above. They were cast with four projections on the bottom to straddle the I-beams, which were chipped to a tight fit and helped to tie things together. The sketch shows two short bolts *f* passing through the flanges, which, how-

ever, were used for the block nearest the facing head only, the other block being left movable to accommodate the shorter pipes. The alining of the bar was done by placing a long pipe in the V's and running two lines parallel with it, one above and one at one side, when, with a pair of inside calipers from bar to lines, quick adjustment was made. The final setting, however, was made after a light cut had been skinned off the first flange, when the pipe was given a half turn, the bar was rotated and the difference noted, which proved to be about 1-32 inch in the width of the flange. A few blows on the wedges alongside the bar boxes and a piece of pasteboard under the rear box cured the trouble.

as many as six pipes being finished in a day, but not every day, as some of the flanges were very hard and the speed of the bar was pretty high, but with the high-speed bar we had a high-speed steel tool to do the cutting, shavings coming from the steel pipe being blue and hot enough to blister.

An account of all the expense, which included the steel for tools, the belts, pulleys, and boxes for bar, patterns and castings for the V's, freight and cartage for the bar and engine to and from the shop, 25 miles away, setting up and tearing down the rig and every proper charge in the way of labor, figured out in the end that each flange cost to face just $2.10, which was less than two-thirds of what we could

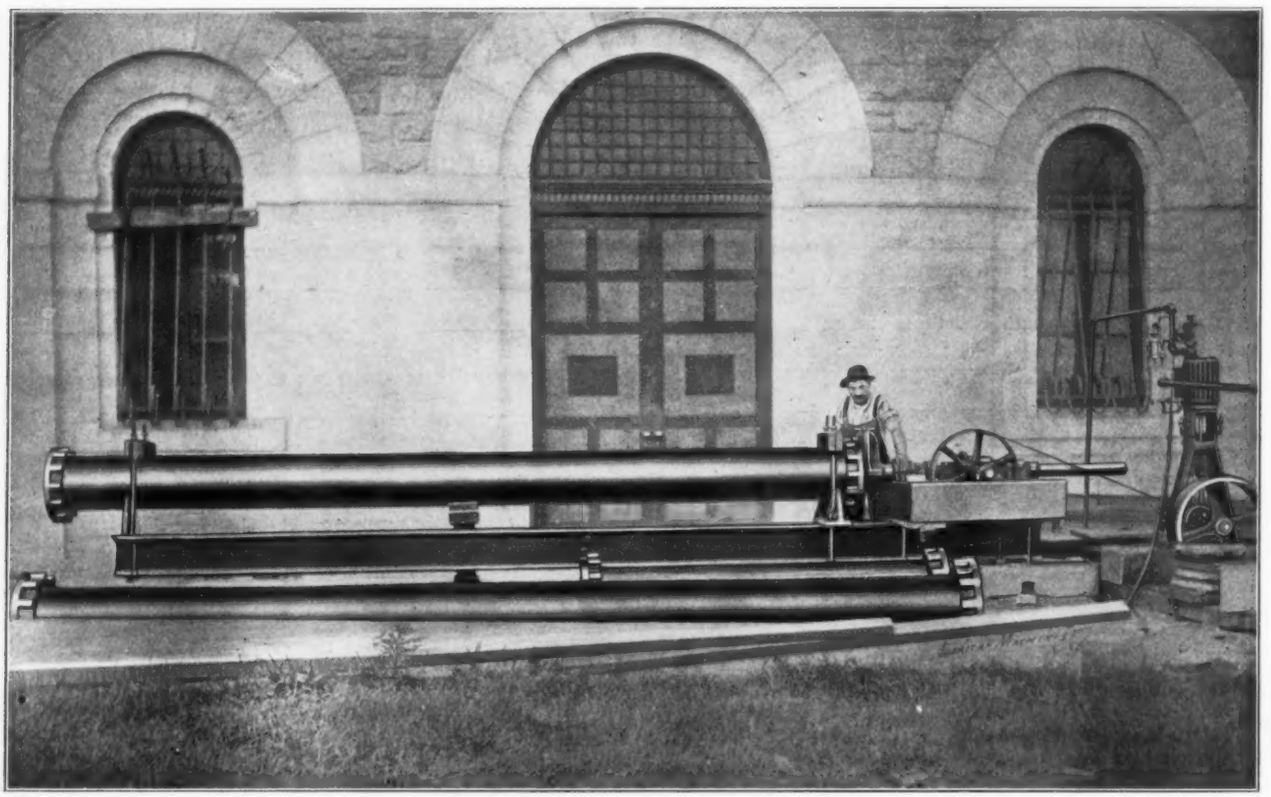


FIG. 3. PIPE FACING RIG COMPLETE.

The facing operation was about as follows: The pipe was run along the ground on wooden rollers, then rolled up two planks into the V's when the clamps were put on, and one end faced. The pipe was then turned end for end and the operation repeated, the turning being quickly and easily done by two men. A hydraulic jack was located at the center of the pipe on a plate lying on the ground and between the I-beams. A piece of wood was hollowed out to fit the upper end of the jack with a V in its upper side to take the pipe. One man pumped up while the other steadied the pipe until it cleared everything, when it was swung around and lowered again, just as quickly and with half the noise of the average traveling crane.

The rig proved to be surprisingly stiff,

figure it by any other means at our command.

Numerous ways other than the one finally adopted were thought of, but all had the undesirable feature of making it necessary to center the bar and line it up for each pipe and in some of the schemes for each flange. The plan described was pretty nearly fool-proof and the work was about as good as that done on the average lathe.

The English language has a busy time of it in providing for the new wants of the talkers and thinkers. The X-rays, the Finsen treatment for lupus, the operation of radium for various ailments, and what-not—where are the verbs for these? A man is guillotined or hanged; his leg is amputated; he is trepanned. What is it when he is rayed, Finsened, radiumed?

Echoes From the Oil Country—The Touchstone of Reforms, "Will It Pay?"

No, I am not a reformer; that is, not of men. I have been almost afraid sometimes that I should be classed as a pessimist because of the the hopeless feeling I have when I think of the things that are mechanically right, but which I fear will never be *the* things. The things that seem mechanically wrong, and which yet are, are still more numerous, and seem just as fixed in their way of staying with us as the good things are in their way of staying away.

There may be many reasons why things are done, or not done, but I have about decided that it all gets down to one thing after all; and that one thing is, will it pay?

I have always thought that the metric system of weights and measures was a good thing, and have always wondered why "they" did not use it. "I" did not use it because I did not think it would pay "me." When my business gets where I think it will pay "me" to use it, it will seem very strange to me to find how obstinate many of the rest of the world are. When the mechanical world is thoroughly convinced that the metric system will pay "me," the "me" that is ever present with each one of us, won't there be a landslide toward taking it up? It will not make any difference whether it hurts "them" or not. When it is theory that confronts us "they" seem to be the parties whose interests are considered, but when we get down to the practical application the question becomes "will it pay me?"

When these things come up there is one little point on the job, of forecasting, that it is well to remember and that is, "As a man *thinketh* so is he." Can "we" be made to think it will pay?

Several years ago I successfully urged the adoption of the United States standard sizes for bolts and nuts in my world. I had several reasons for doing so. I could not be sure what size bolt or nut would come when the ordinary was ordered. Each maker seemed to have a standard of his own, and even that one seemed to be a sort of movable affair that depended on the stock that chanced to be on hand when the order was received. Nothing but a monkey-wrench would adapt itself to the variety, and a firm dislikes to send a wrench of that kind with a cheap machine. Even a good monkey-wrench does not offset the appearance of four different sized nuts on the same sized bolts. Besides that, a U. S. standard tap would often make a very respectable job of a thread that was too loose for a V-thread stud or cap screw, which was a consideration in job work, and then "everybody that was anybody used them."

One day a nice man called. He was a salesman—not one of those jobbing salesmen who sell, or try to sell, everything, but a man that only sold drills, and taps, and the things directly connected with them. He sold good goods and we were in need of some. Among the orders given was one for some taps.

"What else do you want?"

"That is all this time."

"All right. I have everything down, but there is one thing I want to ask. What thread do you want the ½-inch taps?"

"I ordered them U. S. S. Did you not put it down?"

"Oh, yes, I have it down just as you gave it to me, six ½-inch U. S. S. plug, hand taps. What thread shall I have sent?"

I looked at him just as severely as I could, but it did not seem to "phase" him. I did not intend that he should escape entirely. "If I had a big club I think I would be justified in hitting you over the head with it."

"I beg pardon, but really I do not quite understand."

"I just want to know one thing. How many pitches does your firm send out for ½-inch U. S. S.?"

Seeing that something was wrong he looked in his catalog before he answered, and seemed very much surprised to find only one mentioned, and I was no less surprised at the excuse he gave. "Really I have very little call for U. S. S. taps, and I always supposed that the threads ran the same as the others."

This was not a very old man, and he came from the West. I think I was about as far East as he traveled. Some time after this I inquired of several jobbing salesmen what the proportion of U. S. S. threads was to the whole number they sold—that is, on bolts, nuts, cap-screws and set-screws—and they all assured me that it would not be a quarter of the entire number. I thought there must be a mistake somewhere, as I had been using them for years and I had begun to think that everybody else must surely be using them by this time. When I looked over some catalogs at hand I found that most of them had a beautiful little foot-note in places where taps, cap-screws, set-screws and other such things were listed, which said that V-threads would be sent in case the kind of thread was not specified. That seemed to indicate that it was the prevailing kind.

I have a recollection of hearing of a society that is quite popular with the ladies at least in some sections of the country. It is called the "Home Missionary Society." We need to copy after them in the mechanical world and organize a Shop Missionary Society that will try to enlighten the heathen within our borders as to the benefits to be derived from system, order, uniformity, standards, etc. That I may not seem to be inconsistent I will say that I advocate the formation of such a society because if it did its work well it would make life easier for me, and the argument to use as a lever with the other fellow is that it would pay him. If you can't prove to him that it will pay him, or at least make him think that it will, you might just as well let him alone. Hunt up someone that you can make believe it will pay. When all adopt a thing who would get a profit by doing so it will be in general use, or else it has not much excuse for its existence.

I wish that I could get the ear of everyone that puts out a catalog. I have heard that there is some kind of a standard for catalogs; I have also a lot of catalogs that lately I have been trying to reduce to at least a semi-civilized state, and I have reduced many of them to the waste basket. If the people who were so kind as to urge these catalogs on my attention had all put them in convenient form for me to handle and get at, it might have served their purpose better; that is the side I wish to urge on them, while I know it would save temper and patience for me.

This is about the mental attitude my stock of catalogs produced: "As I have a little spare time I will sort up and rearrange this lot of catalogs that has been accumulating and put them in with the old standbys. Here is a nice little one. It has a strong back on it, that will stand handling. It's only paper, but it is stiff enough to stand up on a shelf, and it won't open half up if it is laid down. Here is another one on the same subject, and it goes into the scrap pile. It is twice as large as the other one, and if the firm make their goods as poor and inconvenient as their catalog is, I don't want any of them. There is a lot of these big sheets of paper that have to be folded several times to put them anywhere, that I won't keep. Some day I may want to know what they can tell me, but I will take the risk rather than try to take care and keep track of them. Here is a nice book. It has a leather cover on it. We do not use anything they make, and I don't know as we ever will, but I will just keep it anyhow. I may be able to give it to someone that does have use for it. I do not see why this book was made 9 inches long and 3 inches wide, any more than I do why this one is 4 inches long and 10 inches wide. I am glad there isn't anything interesting in them. Some books are worth carrying in the pocket, but these are not that kind. Here are some that are out of date that I will give to some of the boys in the shop. They are nice books, and the pictures in them are fine, and they have a lot of good information in them.

"I do wish that the fellows that sent these leaflets had printed them on cards that would go into a card file—either 3x5 or 4x6 would be very nice—and then I would have kept every one of them. Wouldn't it be nice if the regular business card of a firm was always 3x5, too? It may not be fair to judge a firm's work by the catalog they send, but really I never like to keep a poor, slouchy, ill-shaped catalog, and I always hesitate about throwing away a nice, convenient, well-made one."

"Hello, there! You seem to be busy today." Tom dropped in and caught me talking to myself.

"Yes, and I was growling about the way *they* did not make things so that they were handy to me. I am unreasonable enough to want folks to consider my convenience in some of these matters, and there are a lot of folks that don't do it. I am afraid I will have to put up with a lot more of it, for I know they won't change their ways until they think it will pay them to, and a cent close up to the eye is big enough to cover up quite a lot of money that is farther off. I find it so myself at least, and I think others are about like I am."

"Do you not think that many of the ones who send you these things never have any idea of how they are received? They want you to have them and must think it will pay them in some way to have you have them, or they would not go to the trouble of having them printed and sent to you."

"More than likely that is all so, and if a man is selling something that has only a short life he does not care to put much money into a description of it; but, on the other hand, here is a catalog that is several years old and it is being thrown away only because here is one of a later date. That isn't the only firm doing business in that line by any means, and this catalog isn't the most elaborate one either, but it has seen steady use just because it was good—not too big nor too small. The printing is clear, and the paper will bear handling. I hope they will prosper, so that they can keep on sending such books around.

"I think that part of the blame for poor catalogs should fall on the printing firms. They might at least urge the uniform sizes. I wish someone could convince them that it would pay them to make only the good, uniform, convenient kind. But what's the use of talking?"

"It may set someone to work that will stir things up, and you will have to admit that the catalogs of to-day are much better, on an average, than those of a few years ago. You may be getting more than your share of the bad ones."

As he went out I wondered whether Mr. Peter Bullock should have received some of this poor stuff that came to me, or whether he had received his full share. His experience seems to run quite close to mine in some lines. W. OSBORNE.

Reports in the German technical press speak with favor of the process of a Mr. Gautsch, of Munich, for rendering wood and other inflammable materials fireproof. The timber is placed in a vessel from which the air is pumped and a solution of sulphate of ammonia and borax ammonia is then admitted. This enters the pores of the wood, and it is said that the color, texture or density of the wood is not affected, but the wood is at once rendered fireproof and proof against decay.

The Planing of Curved Surfaces—II.

BY HOWARD A. COOMBS.

Another attachment for doing the same kind of work is shown in Fig. 5, taken from a patent to Cockfield & Howe, granted in 1882. This attachment consists of a standard *B* clamped to the table and having a socket at *b*, to which is pivoted the chuck *E* in which the work, shown as a link or link block, is held, and another socket at *C* to which is pivoted the segment *K* having a groove *f* therein and a depending arm *L*, the lower end of which has a slot *h* formed to embrace a pin supported by a bracket *M* attached beneath the bed of the planer. A link *H* is pivoted at *G* to one end of the chuck *E* and has its other end adjustably clamped in the groove *f* of the segment *K*. As the table travels the segment *K* will be rocked on its pivot to the positions shown in dotted lines in the side elevation, and consequently the chuck E will be also oscillated. If the point of attachment of the link *H* is axially in line with the pivot of the segment *K*, there will be no oscillation of the chuck, since that pivot necessarily moves in a straight line; but if the link is clamped to the right of said pivot, as shown, the end *G* of the chuck will be depressed as the table moves from the position shown in full lines to that shown in dotted lines at the right, and will be elevated as the table moves to the left of the full-line position. On the other hand, if the link is attached to the left of the pivot of the segment *K*, just the reverse movement will take place and a concave surface will be planed instead of a convex one.

The attachment shown in Fig. 6, which was patented by C. A. Lougee in 1883, is like the Griffen attachment, described above, in that the tool is moved laterally on the crossrail and is governed in its movement by a guide attached to the planer table. The guide is, however, an improvement over Griffen's, for it is made up of two straight elements, the angular positions of which can be altered to vary the curve produced instead of the guides having to be of the same radius of curvature as the piece to be planed. The guide *i* has two guideways, shown as grooves 3, inclined with relation to each other and adapted to receive studs or rollers *k* fixed upon the table *e*, and therefore traveling in unison with the work *f* being planed. The guide *i* is pivotally connected with a bar *m* fastened to the tool slide *d*, which is disconnected from the usual horizontal feeding mechanism, so as to move freely along the crossrail *c* under the action of said bar *m* and guide *i*. The rectilinear movement of the two studs *K* in the in-

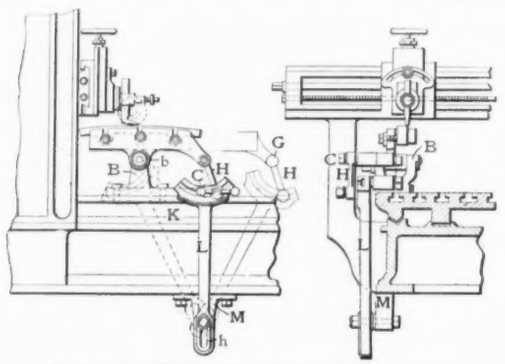


FIG. 5 Cockfield and Howes' Planer Attachment 1882

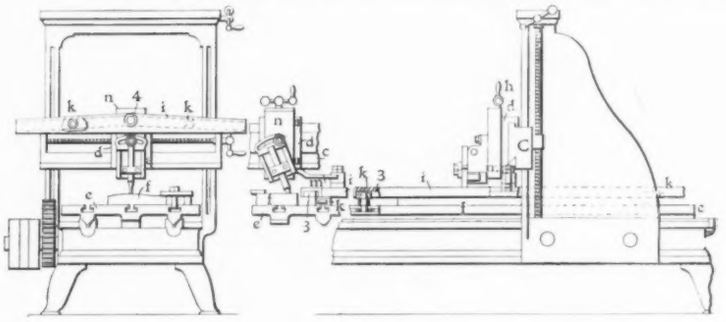


FIG. 6 Lougee's Planer Attachment 1883

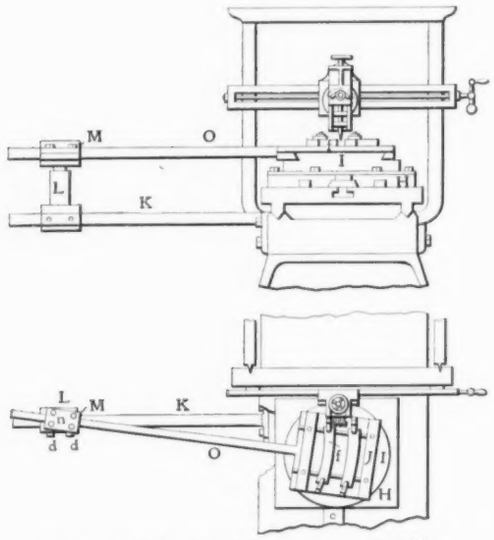


FIG. 7 PAUL'S PLANER ATTACHMENT, 1885.

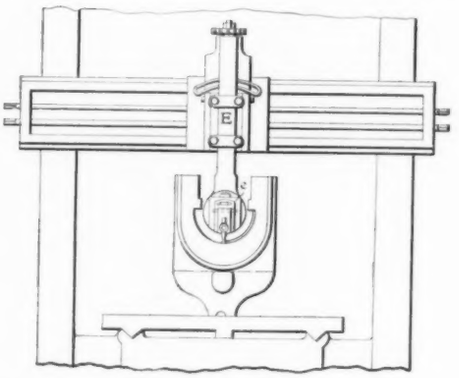


FIG. 8. GEYER'S PLANER ATTACHMENT, 1887.

clined guideway of the guide *i* will produce such a movement of the tool carriage *d* on the crossrail that the tool will trace a true arc of a circle upon the work. The radius of curvature may be varied by placing the studs *K* clear together or farther apart. The guide may be arranged as shown in the end view, to produce a vertical movement of the tool, so that it is fed in a curved path transversely to the table, and in this case the guide *i* is pivotally connected at 4 with the vertically movable tool-holder *n*, and the studs *k* are fixed upon the crossrail *c*, the usual vertical feed of the holder being disconnected and the carriage *D* being fed by the usual feed screw.

Fig. 7, which illustrates an attachment for planers patented by T. H. Paul in 1885, shows a simple construction which can be applied to any planer for producing curved surfaces, such as those required on locomotive links, for example. The construction consists of a base plate *H* clamped to the table and carrying a plate *I* free to turn on the same around a vertical axis, and on the plate *I* a transversely movable work chuck *J*, to which the pieces *f* to be planed are clamped. From the chuck *J* extends a bar *O*, to which is adjustably attached a block *M* which has a pivotal connection with a block *L* adjustably clamped to a bar *K* rigidly attached to the planer bed. Thus, as the table reciprocates, the plate *I* and consequently the chuck and work also are caused to oscillate.

A somewhat different arrangement forms the subject of an 1887 patent to C. F. Geyer, which is shown in Fig. 8. It is simply a tool-holding attachment whereby the tool can be swiveled around so as to plane a concave cylindrical surface. In place of the ordinary tool a bar *E* is clamped on the holder, to the lower end of which a face-plate *e* is pivoted, and on this face-plate is supported the tool-holder proper. The face-plate can be rotated by hand or power from the feed rod in the cross-rail.

Fig. 9 illustrates the use of a templet on the cross-rail to directly govern the vertical movements of the tool as it is fed laterally over the surface to be planed. It is taken from an 1888 patent to G. M. Griffiths, and the scheme will be readily understood from the drawing, although it may not at first sight be apparent why the templet *J*, with which the guide *I* just back of the tool *I'* co-operates, is not shown as exactly concentric with the surface *L* to be planed. The reason for this is that when the tool is at the higher end of the curve, *i. e.*, near the part marked *S*, it is cutting on the side rather than on its extreme point, while at the part *T* the actual point of the tool is what does the cutting.

The attachment for planing the circular guideways of a stationary engine frame represented in Fig. 10, which was the invention of H. Haberlin, of Akron, Ohio, and the subject of a patent granted in 1892, speaks for itself and needs little, if any, explanation. The feeding of the ordinary tool-head *L* along the cross-rail rocks the tool-holder *H* which is pivoted on the supplementary saddle *F* clamped to the cross-rail. By using this attachment there is obviously no need of shaping the frame, as indicated in dotted lines, so as to leave room for the tools to swing around in a circle, as where the guides are to be finished in a boring machine. By casting the frame in the shape shown, it is more compact as well as stiffer.

The above instances of curved planing attachments do not by any means exhaust the list of patented inventions of the sort, but they serve as examples of the different types of devices which have been gotten up for the purpose, and it would not be worth while, even assuming that the editor would permit it, to extend the scope of this article to include other devices employing similar principles. It may be as well to mention that a number of attachments and machines for planing curved surfaces on stone have been patented, none of which have been herein described since they would not be of much interest or use to the majority of machinists.

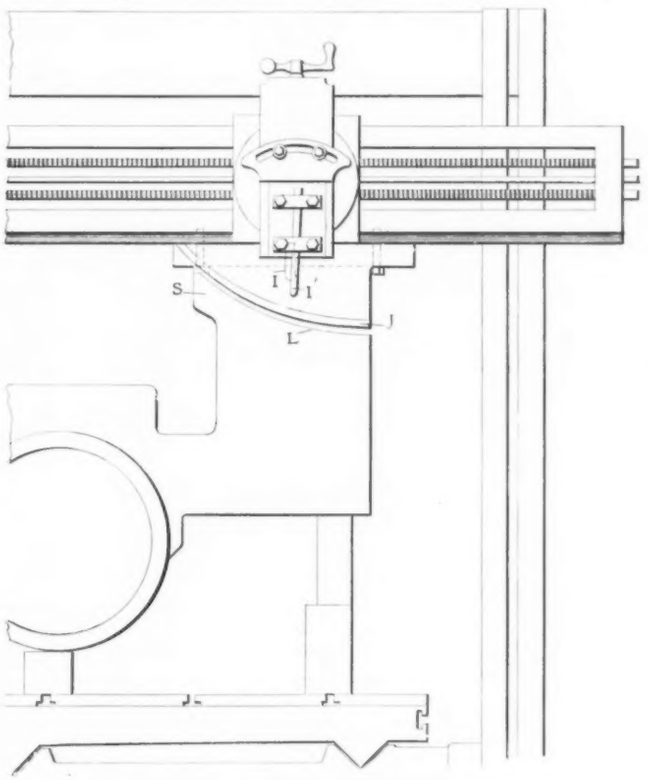


FIG. 9. GRIFFITHS' PLANER ATTACHMENT, 1888.

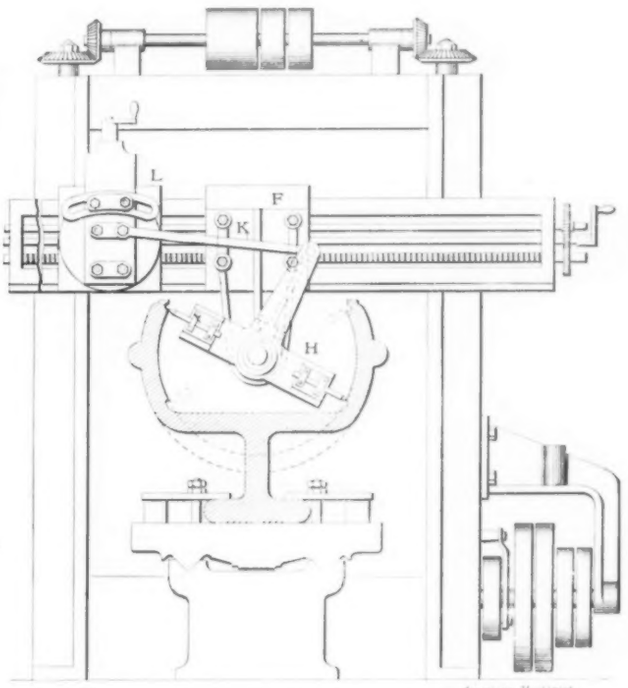


FIG. 10. HABERLIN'S PLANER ATTACHMENT, 1892.

Stories which have a familiar sound, but nothing else to recommend them, are beginning to come in of the unpreparedness of the St. Louis Exposition. The story is somewhat different from the usual form, in that the buildings are far nearer ready than are the exhibits. The buildings in many cases have been held back, especially as to flooring, by the necessity of waiting for foundations for heavy machinery. We may hope that progress toward completion will now be rapid. It is highly gratifying to know that the United States Government Building and its exhibit are both ready.

Details of Lathe Spindle Construction.

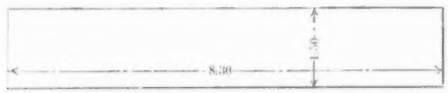
BY JOHN RANDOL.

The No. 5 lathe spindle described in the preceding paper is made on common machine tools, as shown by the operation sheet, Fig. 3, so far as machine cuts are concerned. It is possible that this routine up to operation 13 will be wholly changed by the use of a turret machine.

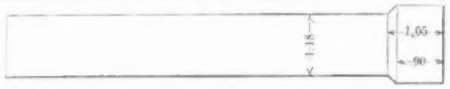
The spindles were formerly made of tool steel, and they would spring in hardening, and sometimes would be broken in straightening; they also were often rejected on account of soft spots in the hardened portions. They are now made

NO. 5 LATHE SPINDLE
OPERATION SHEET

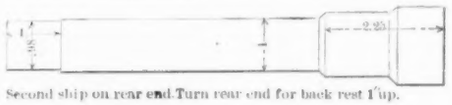
1 Center & Face end to 8.30 (to gauge.)



2 Rough turn rear end.

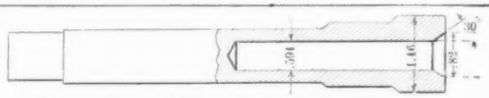


3 Second ship on rear end. Turn rear end for back rest 1" up.

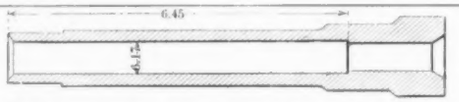


4 Turn front end to 1.46.

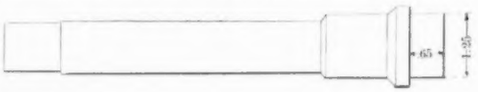
5 Drill & ream front end. (Special taper reamer)



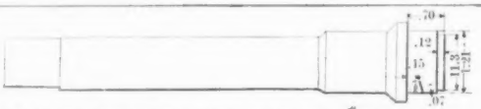
6 Drill & ream rear end. (Special reamer & countersunk slightly.)



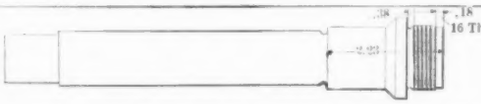
7 Rough turn front end.



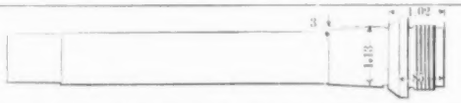
8 Finish turn front end. Drill for thread to run into #52 drill .07 deep.



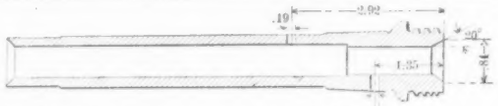
9 Thread front end. Face off end of thread & neck shoulder. Neck rear end of front bearing Square thread. Depth 10 gauge.



10 Turn taper for front bearing to bushings 3. Bushings should come to within .10 of 45 deg. angle.



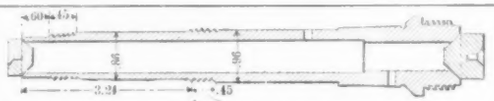
11 Back rest & finish 20 angle 84 dia.



12 Drill chuck pin & pulley screw holes. Chuck pin .12 dia. screw holes .19 dia. Countersunk both holes slightly.

13 Harden & straighten

14 Solder in plugs & center in back rest placing back rest at large end of 3 taper.



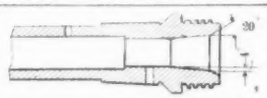
15 Turn rear end to grinding size and cut thread for check nut. 32 thread to inch.

16 Cut spline for rear bearing pin. 3.21 long.

17 Grind pulley size & rear bearing size & rough grind front end. Fit rear bearing and grind to 1.45 front end of spindle.

18 Grind 3" taper.

19 Run in. Remove plug.



20 Grind chuck size. Chuck seat first 4° angle, second 20° angle.

21 Grind front end to 1.20 — 1.12.

22 Grind index size .795 and spindle size .62.

23 Fit chuck pin.

American Machinist

FIG. 3. LIST OF OPERATIONS ON LATHE SPINDLE.

of .35 carbon steel and are hardened by the process and apparatus described in these columns at page 248.

Fig. 3, the spindle finishing operation sheet, shows the sequence of the twenty-three handlings of the spindle in process of manufacture, and gives the toolmaker a clear idea of the machine cuts made on the spindle, but does not detail the grinding operations.

Two other forms of spindles and bearings are shown in Figs. 4 and 5, one with

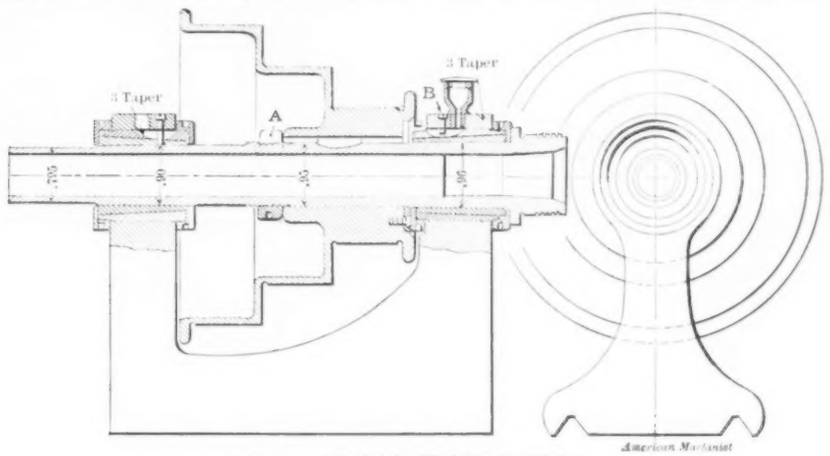


FIG. 4. STRAIGHT SPINDLE BEARINGS.

cylindrical bearings, and one with one taper bearing in front, and two taper bearings, separate from the cylindrical spindle which they support, in the rear.

In Fig. 4 are shown the Sloan & Chace No. 5 lathe cylindrical spindle journals. In this example the headstock box-seats are cylindrical, and of the same diameter. The spindle is cylindrical, larger in front than at the rear, and the spindle end-thrust is taken in both directions on square shoulders, the spindle end-chase being regulated by the split-nut *A*, which adjusts the cone pulley endwise and confines the spindle endwise between a hard plate secured to the belt-cone end and flanged cone-adjusting nuts screwed to the cylindrical outer surface of an outer cone, and the spindle nose flange in front. The outer box-cone takes the inner box cone in which the spindle turns; this inner cone is split its whole length on top, and held from turning by the straight tit on the screw *B*, seated in the headstock, the whole arrangement closing the split inner cone on the spindle to take up side-shake, and advancing the belt-cone to take up end shake. The tail adjustment is similar, two cones relatively adjustable, to close the inner one on the spindle, but leaving the spindle free endwise.

This construction obtains the straight spindle, and also takes care of end-chase in good form, while the side-shake take-up is as good as can be made. This spindle support is good, and is also costly, and demands the best of workmanship.

Fig. 5 shows the Sloan & Chace automatic wheel cutter spindles. The work spindle, shown in section at the top, is the same construction as the No. 5 lathe spindle, which has been described. The cutter spindle is smaller, seated in the same headstock bore diameter as the No. 2 lathe.

It is of the first importance in this tool that the cutter should hold its position lengthwise of the spindle; hence it would not do at all to include the spindle length from outside to outside of the cutter spindle boxes in the "side-shake" adjustment, as is done in the work spindle; because the cutter spindle is liable to warm up in work, and so might displace the tooth space cut in the wheel enough to spoil it. To meet the occasion, the cutter spindle front box is carried out to the left of its headstock in a cylindrical threaded nose, which takes the internally threaded and flanged sleeve *A*, the internal flange abutting on the spindle nose shoulder, and confining the spindle endwise by embracing only about ⅛ inch of spindle length between the sleeve flange and the 45-degree taper of the spindle box. Adjustment of

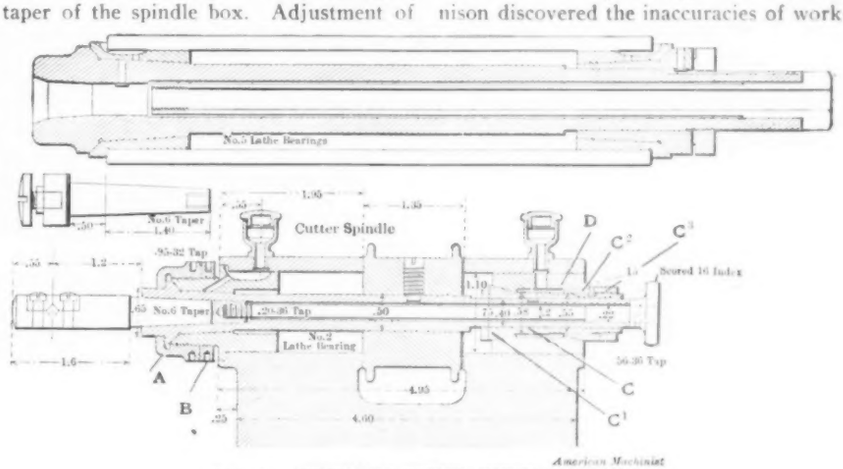


FIG. 5. AUTOMATIC WHEEL CUTTER SPINDLE.

the sleeve *A* is retained by the usual split-nut *B*. The right-hand tail-end of the cutter spindle is ground round and parallel, and is splined to take the long sleeve *C*, which has the integral cone *C*1 formed on its left end, and has an inside stud engaging the spindle spline. *C* is splined to take the sliding cone *C*2, adjusted by the split-nut *C*3, *C* and *C*2 being carried in taper seats in the round hardened and ground box *D*, seated in the headstock. This combination takes side-shake out of the tail bearing, and at the same time permits the cutter spindle to expand and lengthen freely without affecting the cutter position.

Aaron L. Dennison and the Development of American Watch Manufacture.

Having recently noticed in our columns the death of Edward Howard, one of the pioneers of American watch manufacture, we take pleasure in reproducing, in an abridged form, an account, given by Henry G. Abbott in *The American Jeweler*, of the career of Aaron L. Dennison, with whom Mr. Howard was most intimately associated:

Mr. Dennison was the son of a shoemaker of Freeport, Me. He was born in 1812, and in 1822 he was carrying a mason's hod in the village of Topsham. In 1825 we find him earning his own living by sawing wood in the town of Brunswick, his father having removed to the latter place in 1824. Two years later he was working at his father's trade. At eighteen he began to grow tired of cobbling. He was of a mechanical turn of mind and was much interested in watchmaking and kindred mechanical work, and his father apprenticed him to a watchmaker in 1830. In 1833 he went to Boston to perfect himself as a journeyman watchmaker, and shortly after he went into business for himself, but soon gave it up to enter the employ of Messrs. Jones, Low & Ball. While at work here he received the benefit of the advice of Mr. Tubal Hone, then considered one of the finest watchmakers in the country; and it was here in the year 1835 that Mr. Dennison discovered the inaccuracies of workmanship and construction which existed in even the best of hand-made watches. In a letter written at that time he said: "Within a year I have examined watches made by a man whose reputation at this moment is far beyond that of any other watchmaker in London, and have found in them such workmanship as I should blush to have it supposed had passed from under my hands in our lower grade of work. Of course, I do not mean to say that

there is not work in these watches of the highest grade possible to carry the finisher's art, but errors creep in and are allowed to pass the hands of competent examiners, and it needs but slight acquaintance with our art to discover that the lower grade of foreign watches are hardly as mechanically correct in their construction as a common wheelbarrow."

From Boston he went to New York city, but in 1839 we again find him in Boston in business for himself. Here he did repairing for the trade and carried later a full line of watches and jewelry, doing a thriving business. About this time he invented the Dennison standard gage and began to turn his thoughts upon the manufacture of watches on what is now known as the "interchangeable system."

We will here use Mr. Dennison's own words:

"The principal thinking up of the matter was done when I was in business at the corner of Bromfield and Washington streets, Boston; and many a night, after I had done a good day's work at the store and a good evening's work at home, in repairing watches for personal friends, I used to stroll out upon the common and give my mind full play upon this project; and now, as far as I can recollect what my plans then were as to system and methods to be employed, they were identical with those in existence at the principal watch factories at the present time."

Mr. Dennison predicted, in the year 1846, that within twenty years the manufacture of watches would be reduced to as much system and perfection and would be carried on with the expedition with which firearms were then made in the Springfield armory.

In 1849, a friend of Mr. Dennison, Mr. Edward Howard, a clock and scale maker of Boston, had a long talk with him in regard to the manufacture of American steam fire engines. Mr. Dennison did not agree with Mr. Howard in his idea of engine manufacture, but soon convinced him that the manufacture of watches in large quantities on the interchangeable plan would prove a more profitable undertaking. Mr. Howard soon became as enthusiastic over the idea as Mr. Dennison, and together they went in search of a capitalist who was willing to risk some money in the experiment. This gentleman was found in the person of Mr. Samuel Curtis, of Boston, who furnished $20,000 with which to try the experiment. Mr. Howard's partner, Mr. D. P. Davis, was also interested in the experiment. The projectors met at an early date to make arrangements in regard to the starting of the factory and buying the necessary material. We again quote Mr. Dennison's own words:

"I suggested that the first money spent in the undertaking should be for a tour of observation in the watchmaking districts in England, with a view of ascertaining whether the trade of watchmaking was carried on there on the system represented to me by English workmen I had employed from time to time in repairing. Another object I had in view was to find out the source of supply for the necessary materials, such as enamel for dials, jewels, etc."

Mr. Dennison then started for Europe, and, after thoroughly looking over the ground, writes:

"I found that the matter had been correctly represented, but in carrying out their system one-half the truth had not been told. How that the party setting up as a manufacturer of watches bought his Lancashire movements—a conglomeration of rough materials—and gave them out to A, B, C and D to have them finished, and how A, B, C and D gave out the job of pivoting certain wheels of the train to E, certain other parts to F, and the fusee cutting to G, dial-making, jeweling, gilding, motioning, etc., to others, down almost the entire length of the alphabet; and how that, taking these various pieces of work to outside workpeople—who, if sober enough to be at their places, were likely to be engaged on someone's work who had been ahead of them, and how, under such circumstances he would take the occasion to drop into a 'pub' to drink and gossip, and, perhaps, unfit himself for work the remainder of the day. Finding things in this condition, as a matter of course, my theory of Americans not finding any difficulty in competing with the English, especially if the interchangeable system and manufacturing in large quantities was adopted, may be accepted as reasonable."

While Mr. Dennison was looking over the ground in Europe, Mr. Howard was engaged in erecting a factory, and on the return of Mr. Dennison, work was immediately commenced. The factory was built, the tools manufactured and everything started in 1851, and the first watches were placed upon the market in 1853. The company was not a financial success, and they finally made an assignment in 1857. Mr. Dennison was then employed by his successors as superintendent, filling that position until December, 1861.

In 1864 Mr. Dennison interested Mr. A. O. Bigelow, of Boston, in a new factory. Owing to the high price of labor at this time, Mr. Dennison reasoned that it would be better to have certain portions of the movements made in Switzerland, imported to the United States, and set up with the remaining portions which were to be made in America. Accordingly, Mr. Dennison went to Switzerland, and decided that Zurich was the best location. He here gathered the necessary material together, set up the trains and sent them to Boston. Everything went along swimmingly until 1866, when the directors of the company decided to build a new factory at Melrose, Mass., and make the entire watch there. This new idea, however, Mr. Dennison did not approve of, as the company was doing very well as it was, and the change would involve more or less risk. Accordingly, in a short time he withdrew from the company. Mr. Dennison remained in Switzerland until 1870, having taken a contract to furnish certain material for the Melrose Company. The company having failed in 1868, Mr. Dennison returned to America and tried to interest capital in reviving it.

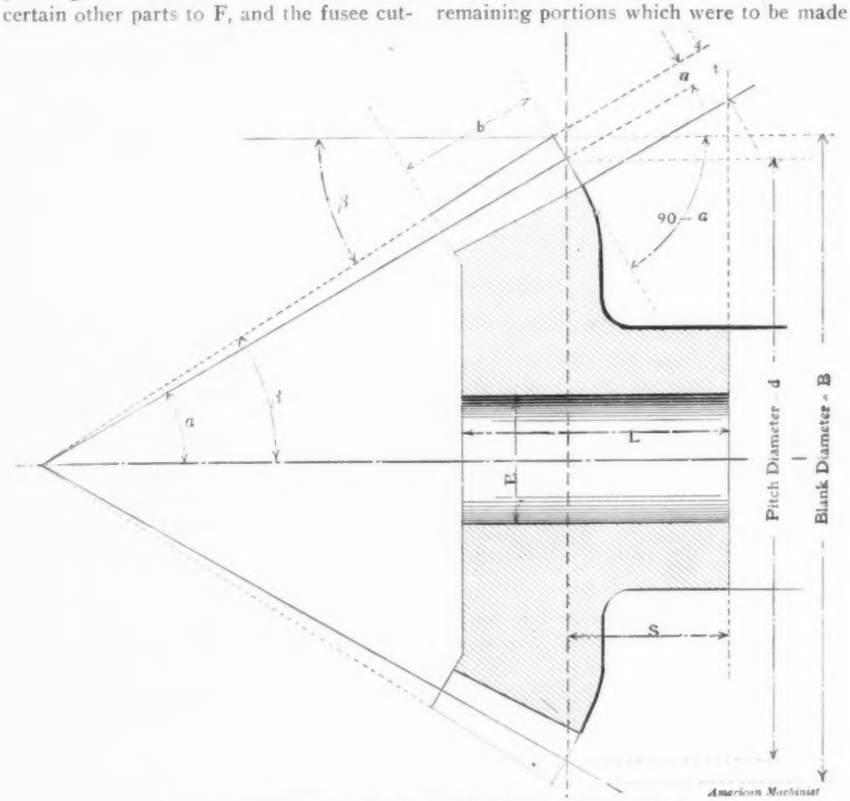


FIG. 1. NECESSARY SHOP DIMENSIONS FOR BEVEL GEARS.

Failing in this, however, he soon went to England, where he interested capitalists, and the plant was purchased and a factory was opened in Coventry under the name of the English Watch Company. Mr. Dennison then went to Birmingham, England, and embarked in the manufacturing of watch cases. In this he was quite successful, the firm being known as Dennison, Wigley & Co. He died at his home in Birmingham, January 9, 1898.

Bevel Gears With Short Teeth.

BY ROBERT A. BRUCE.

The advantage of using a shorter tooth than that given by the ordinary rules for determining the addendum of gear teeth is now pretty well recognized. In spite of the general acknowledgment that the use of such teeth is beneficial, it may be doubted whether much headway has been made in this direction. Large machine-molded gears, however, are generally made with teeth whose addendum does not exceed one-quarter of the circular tooth, the cost of the change being inappreciable where old pattern blocks are used, and *nil* where new blocks have to be made. But for cut spur gears new cutters would be required or at any rate the cost of correctly grinding off the tips of old ones would be a very serious item, and hence, except in the case of special gears made in sufficient quantities to pay for special cutters, the balance of advantage lies in adhering to established practice. There is, however, a large field for the use of shorter teeth in cut bevel wheels. Nine out of ten bevels are cut in a templet machine and the use of shorter teeth leads to considerable economy in production, as the time needed for planing out the shallower tooth space is necessarily less than that needed for removing the stock in gears of standard proportions. It is not surprising, therefore, to find that in many establishments it has become a recognized practise to use one set of proportions for spur wheels and another for bevels. The proportions proposed in the following tables are based on the assumption that the addendum can be profitably reduced to one-quarter of the circular pitch, the depth below the pitch line being made 5-16 of the pitch. The proportions which follow apply only to bevel wheels whose shafts are at right angles.

It is quite common to find either unnecessary or insufficient dimensions on the drawings of bevel wheels, and even when they are sufficient in themselves they are not always conveyed in the form most readily comprehended and applied by the workman. In Fig. 1 the dimensions given are sufficient to cover all the needs of manufacture. It should be noted that there is no logical necessity for the dimension a (the addendum), but its appearance is justified by the fact that it is really easier to scribe the pitch line on the blank by measuring a from the largest diameter than to caliper direct. Only two angles are required, viz.: the pitch cone half-angle α, which is wanted for setting the blank in the gear planer, and the blank angle β, used for turning that portion of the blank which forms the tops of the teeth. The angle α is determined directly from a table of natural tangents as follows:

$$\tan.\ \alpha = \frac{d}{D} = \frac{n}{N} = \text{ratio of speeds} \quad (1)$$

where n = number of teeth and d = diameter of wheel considered, N = number of teeth and D = diameter of mating wheel.

The angle β is indirectly obtained by finding the angular increment $(\beta - \alpha)$, which is the angle subtended by the addendum a. Now obviously

$$\tan.\ (\beta - \alpha) = \frac{a}{\text{slant side of cone}} \quad (2).$$

But since $a = \dfrac{\text{circular pitch}}{4}$ and $(\beta - \alpha)$ is in all practical cases sufficiently small to enable us to write the angle itself instead of its tangent, we have finally the very simple result:

$$\text{Angular increment} = \frac{90^\circ}{\sqrt{n^2 + N^2}} \quad (3).$$

A method of obtaining the angular increment without calculation is given in Fig. 2. Its use may be illustrated by tracing the thickened lines. The given gear has 66 teeth and the mating gear 42. The point A is found where the ordinates locating these numbers intersect and the nearest circle is followed to B and thence an ordinate is followed till the curve is cut at C, which gives the angular increment as 1° 8'. The accuracy obtained is more than sufficient. The reference curve is obviously an hyperbola. The blank diameter B is found by adding to the pitch diameter

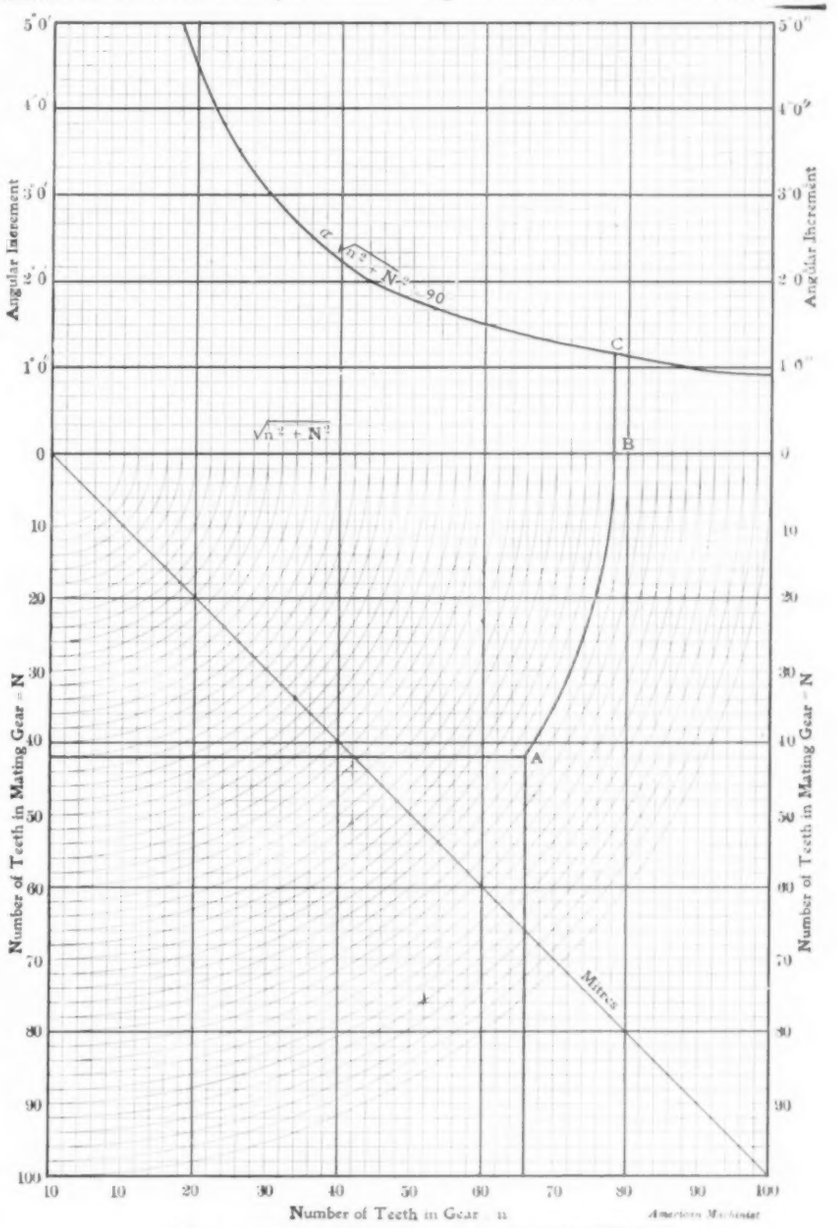


FIG. 2. DETERMINATION OF ANGULAR INCREMENT.

a quantity termed the diameter increment. Diameter increment $= 2\ a\ \cos.\ \alpha$ (4)

This may be obtained by inspection from Fig. 3. Each curve covers all values of α and one diametral pitch. For example, half angle of pitch cone $= 33°$ diametral pitch $= 3\frac{1}{2}$. Find A on the base line giving 33°, and trace vertically to B, where the diameter increment is found as 38″. The only remaining dimensions that require consideration are a and t, which will be found for the most common pitches in the table.

Diametral pitch.	Addendum, a.	Whole depth, t.
2	.3927	.8836
2½	.3141	.7067
3	.2618	.5890
3½	.2244	.5049
4	.1963	.4417
5	.1571	.3535
6	.1309	2945
7	.1122	.2524
8	.0982	.2209
9	.0873	.1968
10	.0785	.1766

TABLE OF PITCHES, ADDENDA AND DEPTHS OF TEETH.

In the case of miter gear we have $\alpha = 45°$

$$\text{angular increment} = \frac{90°}{1.414\ n} \quad (5)$$

$$\text{Diameter increment} = 1.414a \quad (6).$$

In each of the diagrams Figs. 2 and 3 special lines marked "miters" indicate these relationships.

Leeds, England.

In Halifax, Nova Scotia, there is a telephone to each 27 persons and there is an average of 11 calls per day for each telephone.

Gas as Fuel in Mechanical Heating Processes—Why the Dearer Fuel is Often the Best to Use.

BY EDWARD P. REICHHELM.

Heat is indispensable in the transformation of metals and is the prime factor which determines the quality of the finished product. The great industries which produce steel and other metals and supply them in merchantable shape have made notable improvements in their heating processes since natural gas, petroleum and producer gas have largely supplanted coal. In the numerous industries, however, which convert the cruder forms of metal into highly finished merchandise, no substantial progress was made until gas blast furnaces became a recognized specialty in mechanical engineering, and had demonstrated that the costliest fuel, which is gas, could be profitably used in mechanical

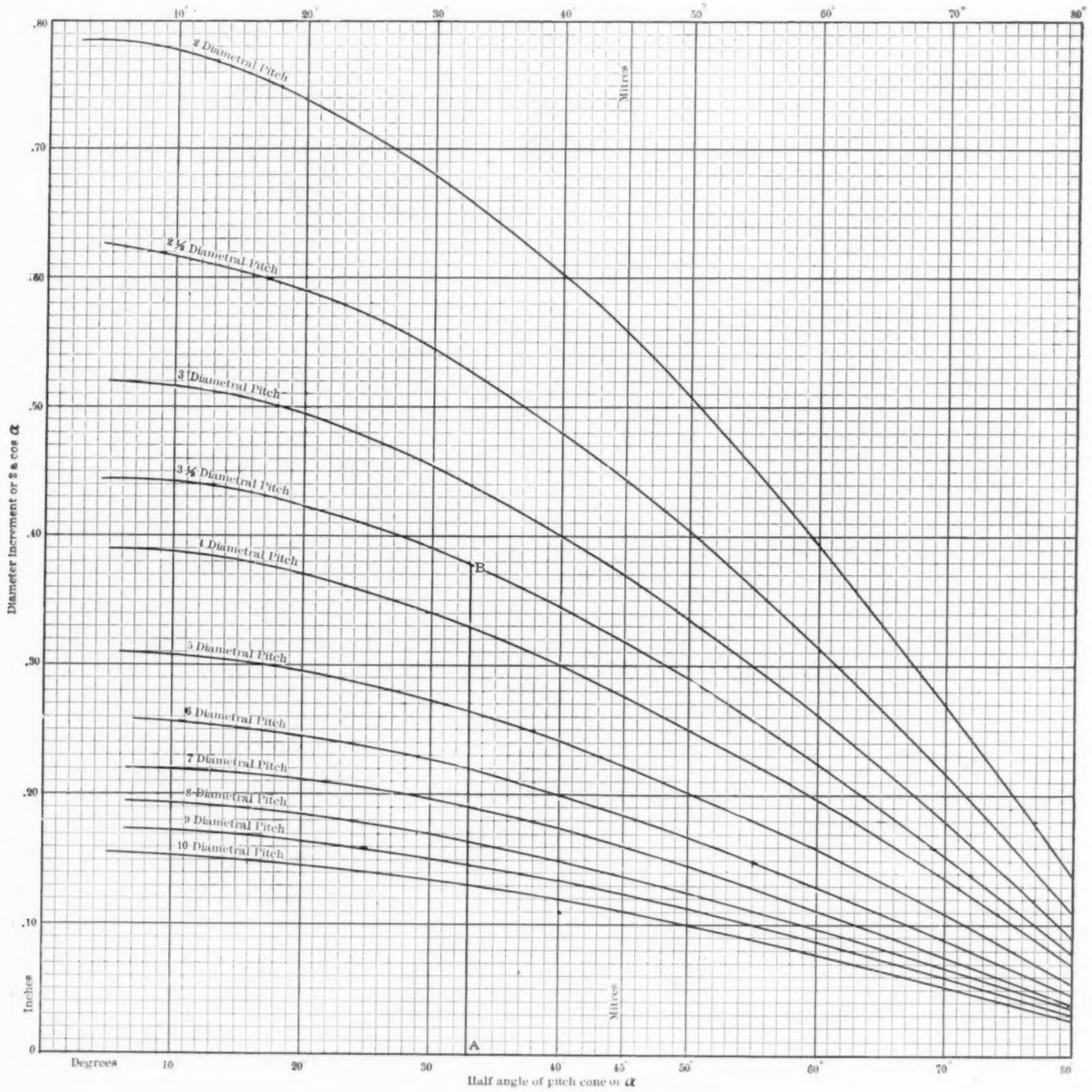


FIG. 3. DETERMINATION OF DIAMETER INCREMENT.

heating processes when measured by net results.

The quality of most of the highly finished products of steel, as well as other metals, depends so much upon correct heating that the single item of the cost of fuel frequently becomes a secondary consideration. A ton of coal theoretically contains 28,000,000 heat units, while illuminating gas contains about 650,000 heat units in 1,000 cubic feet. The average price of coal may be figured at $4.00 per ton and gas at $1.00 per thousand, hence to obtain the heat units contained in a ton of coal, about 43,000 cubic feet of gas would be necessary, which would cost $43.00, as against $4.00 for a ton of coal. And yet against these tremendous odds gas blast furnaces have forced their way into hundreds of factories where they have won notable victories over coal, and are now considered indispensable in many industries because they have demonstrated that the difference in the cost of fuel is not only compensated for by a better and more uniform quality of work, but that the greater output obtainable at the same labor cost makes the dearer fuel properly used the "cheapest in the end."

Coal-heated furnaces and forges are comparatively inexpensive and use the cheapest fuel, but require experienced mechanics, known as melters, blacksmiths, hardener and temperer, annealer, etc., to handle them. These mechanics earn their wages mainly by their proficiency in the successful manipulation of the fuel and by an eyesight trained for judging heats, and much time is unavoidably spent in feeding and nursing their fires which, with coal-heated furnaces, requires skill and experience. At first, therefore, many of these artisans did not favor gas furnaces which apparently made an important part of their acquired skill unnecessary and their services less valuable, while employers could be easily convinced that coal was the cheapest fuel, and that gas furnaces could not be made an economical success.

Another objection to their introduction was the fact that while an ordinary coal forge could be used for a great variety of work the use of gas would require several different kinds of furnaces for different operations, and much of missionary work had to be done before a manufacturer was convinced that an expensive outfit of gas furnaces, using the most expensive fuel, could be made a profitable investment. This, however, has now been done on an extensive scale, and hundreds of factories here, as well as in Europe, were eventually induced to try the new system. This was done by ascertaining carefully the wants of each factory and making experiments with their special work, for which heating devices were then designed, not only with a view to the utmost economy in gas consumed, but mainly to insure convenience, efficiency and speed of operation.

The introduction of such a plant in one factory led to the adoption of the same system in others in the same locality, until a demand for gas furnaces resulted which created a practically new industry, the manufacture of heating tools, which are now extensively used wherever metals are transformed into highly finished merchandise.

These modern heating tools have demonstrated that out of 100 dies not more than one need be lost in hardening, and in the very important process of annealing the losses attributable to imperfect annealing have almost entirely disappeared. Tempering has become one of the simplest operations, while formerly regarded one of the most difficult and delicate. The losses incident to overheating and underheating in forging, hardening and annealing have been reduced to an infinitesimally small percentage, and yet even now gas blast furnaces encounter a peculiar aversion to gas bills, and the compensating advantages are frequently forgotten.

In many heating processes which can only be performed perfectly with gas, coal or crude oil is still used, on account of the difference in the cost of these crude fuels as compared with gas. This difference is indeed great enough so that in the heavier and cruder work coal and petroleum can be used to advantage, but it is also certain that crude fuels cannot do the work of gas in the application of heat with any degree of precision. Where accurate graduations of heat are indispensable for perfect work, gas is the only fuel which is profitable regardless of its ordinary cost. This is evident from the fact that to obtain the perfect combustion of any fuel, the air must be supplied to it in precisely the right proportions, and these must be variable according to the temperature required.

To mix coal and air in proper proportions is manifestly impossible. To mix petroleum and air is much more feasible, but to do it accurately in variable proportions is exceedingly difficult. Only substances so much alike as air and gas can be mixed perfectly, and in the definite proportions required for accurate gradations of heat.

An additional important advantage which the gas fuel affords is, that the proper mixture of gas and air can be distributed at will in a combustion chamber of any desired shape, and that the combustion is readily confined to the space to be heated. The ability thus to confine the combustion to a heating chamber and to inject the mixed fuel just where it is wanted—thus doing away with the necessity of heating space not occupied by the work—produces an economy in the use of gas which is impossible with cruder fuels, and a large percentage of the great difference in the cost of gas and other fuels is thus wiped out. It is safe to say that the waste of heat units in burning coal is 85 per cent., of crude oil 75 per cent., and not over 20 per cent. in using a good gas.

It has been demonstrated, in many instances, especially in annealing and hardening, that even when counting only the cost of the fuel itself these processes cost lsss for gas than if either coal or oil is used, and this, with the further advantage of perfect work, would seem to open a much wider field for the use of gas blast furnaces than is now occupied by them.

The reasons why gas blast furnaces are economical, and which do not apply to furnaces heated by other fuel, may be briefly summarized as follows:

1. The fuel is completely utilized by perfect combustion, which is confined to the space to be heated.

2. The waste of heat is reduced to an unavoidable minimum which escapes from the open entrance or radiation through the furnace lining.

3. The combustion gases pass from the furnace through the smallest possible vents, and at so low a temperature that no "live heat" is diverted from the work.

4. And all this in addition to great convenience in handling, cleanliness, uniformity, and the absence of oxidation, must necessarily produce, even at higher cost for the single item of fuel, paying net results.

Time Saving in Planing.

Fully six years ago—to be exact, at page 135, Vol. 21—Henry Hess presented in these columns a diagram showing the relatively slight gain in time secured through a mere increase in the return speed of planers as compared with that derived from a corresponding ratio of increase in the speed of the cutting stroke. Nevertheless there are to-day quite a good many persons who in watching a group of planers in operation will, upon discovering which of the number has the highest quick-return ratio, look upon that tool as the most efficient of the lot without realizing for a moment that another with but slightly faster cutting stroke is really the more efficient machine, altho its return speed ratio may be comparatively low.

The G. A. Gray Company, of Cincinnati, has recently issued a circular on high-speed planing which contains some highly interesting reading matter along this line. The circular reads in part as follows:

"We are frequently asked, 'What is the quick-return ratio of your planers?'

"The person asking such a question seems to assume that this ratio determines the *efficiency* of a planer, and that a comparison of such ratios for various planers indicates their relative efficiencies. Both of these assumptions are *radically wrong*. The mere ratio of return and cutting speeds is *no indication whatever* of the efficiency of a planer, and a comparison of such ratios for various planers is of no value unless the *actual cutting speeds* are known.

"The man who asks, 'What is the quick-return of your planer?' assumes that a return of 4:1 *must* be more efficient than 3:1. If the cutting speeds are *alike* on both planers, then the comparison is valid;

but if the cutting speeds are *not* alike, then both speeds must be known before a basis of comparison can be established. Thus, a planer with a quick-return of 2:1 *may* be really more efficient than another with a quick return of 4:1. It depends entirely on the actual *cutting speeds*, as may be understood from the following elementary calculation, viz.:

"Assuming the cutting speed to be 24 feet per minute, then a stroke 12 feet long is made in half a minute; and if the quick return is 2:1, then the return stroke is made in ½ of ½ = ¼ minute. Thus, *one* 'round trip' is made in ½ + ¼ = ¾ minute—*i. e.*, at the rate of 80 round trips per hour.

"Assuming the cutting speed to be 18 feet per minute, then a stroke 12 feet long is made in 12-18 = ⅔ minute; and if the quick return is 4:1, then the return stroke is made in ¼ of ⅔ = 1-6 minute. Thus, *one* 'round trip' is made in ⅔ + 1-6 = 5-6 minute—*i. e.*, at the rate of 72 round trips per hour.

"Similar calculations with various other cutting speeds and return ratios give the results embodied in the following table:

					Round trips per hour.
With a cutting speed of	18 ft.	and a quick ret'rn of	4:1	a planer makes	72
	20 ft.		3:1		75
	24 ft.		2:1		80
	40 ft.		2:1		133
	60 ft.		1½:1		166

"From the above it is plainly evident that the *cutting speed* is the *principal* factor in determining and increasing the efficiency of a planer, and of infinitely more importance than mere magnitude of quick-return ratio."

Some Interesting Milling Machine Attachments Designed and Used in a Jobbing Machine Shop.

As most of our readers know, Frederick Hart, of Poughkeepsie, N. Y., has a machine shop especially equipped for doing experimental and special work of all kinds. This means that he must do almost any kind of an operation upon almost any kind of a piece, and in order to do this with reasonable facility the usual standard machine tools found in this shop are equipped with a good many special devices. We have shown some of these, notably the arrangement by which a Brown & Sharpe universal grinder is fitted to do surface grinding, and we herewith show photographs of some appliances fitted to a universal milling machine.

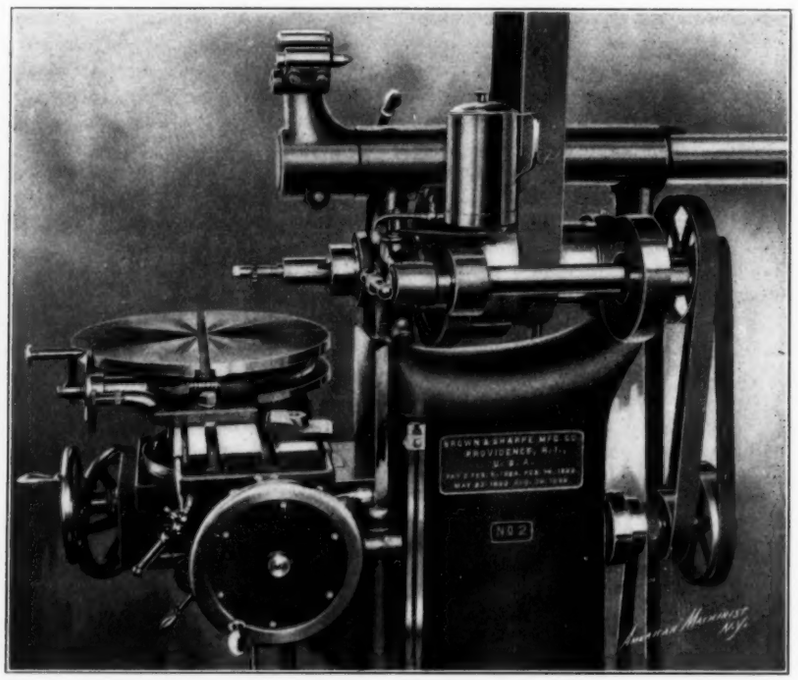


FIG. 1. HIGH-SPEED ATTACHMENT AND DIVIDING TABLE ON UNIVERSAL MILLER.

Figs. 1 and 2 show a high-speed attachment and also a circular milling or dividing table; the latter view showing the two attachments dismantled and lying on the milling machine table. The high-speed attachment consists of a long shaft which passes through the spindle of the machine. The bearing at the front end of the machine consists of a taper bronze bush, which is slipped into the taper at the end of the spindle. That which looks like a collar just at the left of this bushing, Fig. 2, is really a nut fitted to the bushing to withdraw it from the main spindle. Just beyond this bushing, Fig. 2, is shown a pulley. This pulley has a bushing on which it rotates, and the bushing is screwed on in place of the nut on the end of the main spindle. That which looks like a hub on the pulley is really a collar which is fastened to the high-speed spindle by a set-screw and key and is driven from the pulley by means of two pins which slide easily in the pulley but are tight in the collar. This obviates any end thrust due to improperly attaching the collar to the high-speed spindle. To be able to change the cutters without taking out the spindle every time, it was made sufficiently long to have a drift hole outside of the bronze bush. This is plainly shown in both of the photographs.

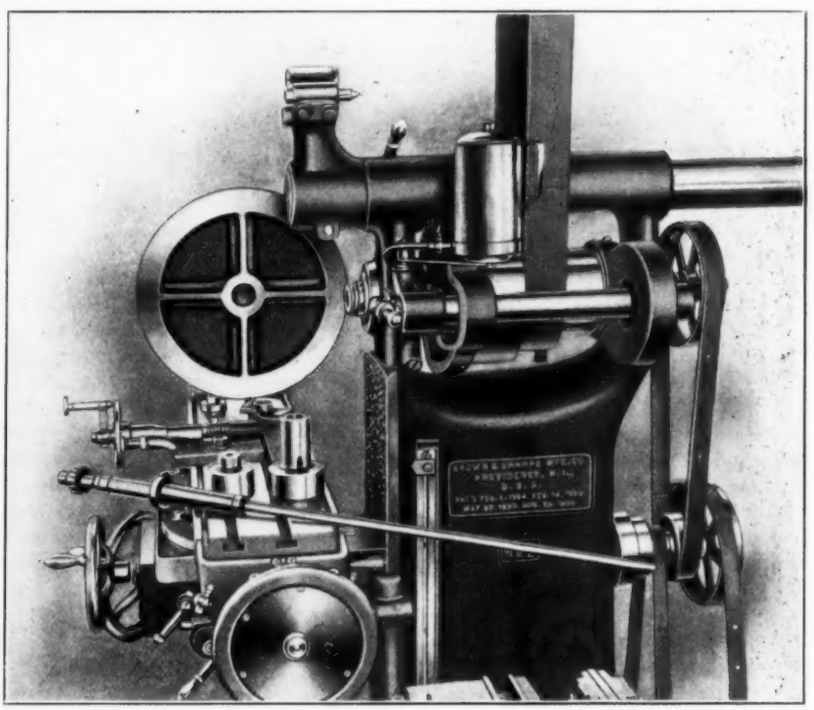


FIG. 2. HIGH-SPEED AND DIVIDING TABLE DISMOUNTED.

This attachment being entirely independent of the overhead arm, the outboard center can be used in the end of

any spindles or cutters. Should it, however, not be desirable to use the outside center and at the same time have a reasonably rigid cutter, a bearing is provided, shown on the machine in Fig. 1 and at the right of the table in Fig. 2, which screws on to the nose of the main spindle, and has a bearing at its outer end close to the end of the high-speed spindle. It is not necessary to remove this to change cutters, as the drift can be used through a slot provided in this bearing. The pulley on the lower stud of the feed gear is screwed on in place of the usual nut. The whole thing can be put on or taken off almost as easily as any cutter arbor.

The dividing table or circular milling attachment is so made that it stands very close to the platen; there being no bottom plate provided for it at all and the platen of the machine being made to perform this function. Bolted into either of the slots of the table is a circular hub; this is made a close fit to the hole in the center of the circular table. The casting carrying the worm wheel and dividing plates also assists in holding down the table. There are also provided three or four clips which can be bolted in any of the slots and so hold down the circular table by means of the bottom flange. These clips are made with slots of two widths, so that they will either bind the table tight or give it just freedom enough to rotate. This makes a very rigid attachment, and, not taking up much hight, has been found very useful.

Figs. 3, 4 and 5 show an attachment for the larger plain machines, which can be used for a variety of work that would otherwise have to be taken off of the platen and finished on some other machine; which, of course, is all right in making machines in large quantities, but for tooling an intricate piece of work, of which only one is to be made, this attachment becomes very useful.

Fig. 3 shows the attachment with the slide working vertically, when it may be used for slotting key-ways or any work of that nature.

Fig. 4 shows it swiveled to an angle and planing out an inclined surface in the bore of a piece of work, which has just been milled, and all of the work done on the platen.

No. 5 shows it in a horizontal position, where it can be used as a draw cut shaper.

Referring to Fig. 3, there will be seen standing on the end of the platen two lengthening pieces, which may be inserted between the main frame of the machine and this attachment, thus giving the tool a distance of 33 inches from the vertical slide of the main frame. When projected out so far additional strength can be given to it, as shown by the support just back of the vibrating link; or, if being used in an angular position sufficient to clear the overhead arm, it may then be strengthened as shown in Fig. 4, or the bearing may be taken in the braces at the end of the knee. The spindles shown on the

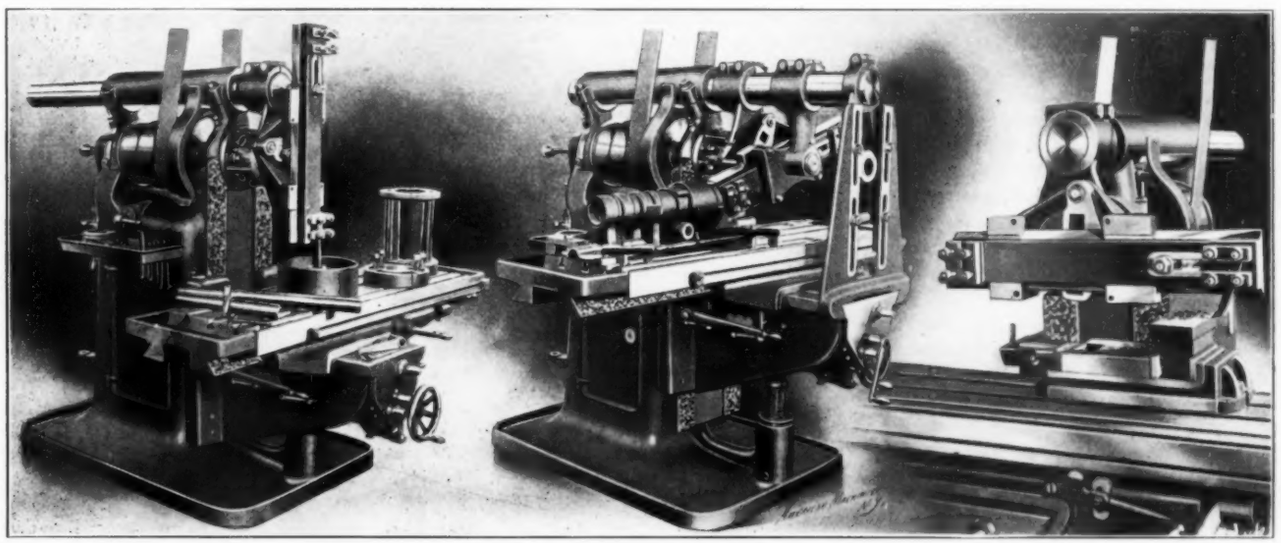


FIG. 3. SLOTTING VERTICALLY.

FIG. 4. SLOTTING AT AN ANGLE.

FIG. 5. PLANING HORIZONTALLY.

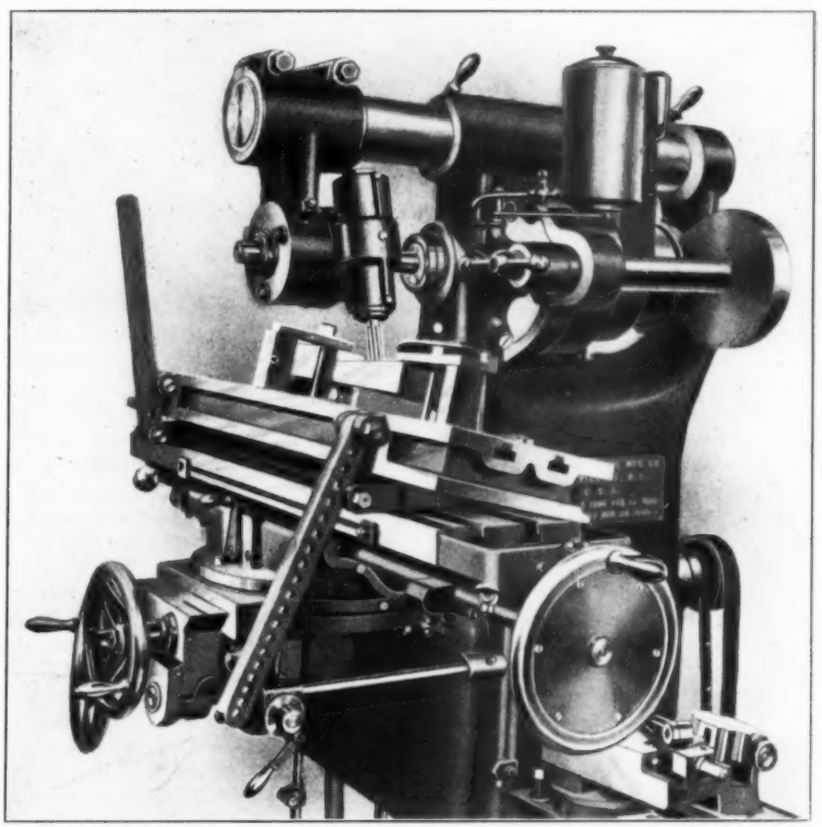


FIG. 6. TILTING TABLE FOR UNIVERSAL MILLER.

table, Fig. 3, are for use in either of these lengthening attachments.

The tilting table, Fig. 6, was made because in a great many instances work required milling at various angles to the platen lengthwise. This, of course, it is ordinarily impossible to do for any length, as very few of the vertical milling attachments swivel in that plane, so this table was designed to tilt as shown in the photograph. The holes in the links are drilled for every 5 degrees, any intermediate angle being obtained by laying the link against the bolts and tightening the bolts up. This has been found to hold it sufficiently rigid for all practical purposes. In the bottom of this table are three holes, one at each end and one in the middle, of the same diameter as the one in the center of the indexing plate (Figs. 1 and 2), and these will therefore fit over the same center block. This has been found very useful indeed for milling radii of a greater length than the circular milling attachment will take.

This table is very frequently used for

FIG. 7. TILTING TABLE USED AT RIGHT ANGLES TO PLATEN.

bolting at right angles to the main platen and mounting the centers on it, thereby accommodating work which it would be difficult to handle otherwise. Fig. 7 shows it being used in this way for drilling and counterboring the hubs of propeller blades.

What do you think of patenting a hole and making thousands, and probably hundreds of thousands of dollars on it? Simply a hole, and that's all. That is what was done by the manufacturers of a certain style of toothbrush which has a wide sale. The hole was drilled in the handle of the brush near the end, and with each brush was given a little hook, with instructions to hang the brush on the hook by use of the hole. The thing was widely advertised, with the result that millions of the brushes were sold at prices much higher than others just as good. The patented hole and the advertising did the trick. The patent expired a few months ago, however, and now any manufacturer of toothbrushes can sell holes with his goods.—*Milwaukee Evening Wisconsin.*

Letters From Practical Men.

Suggestions for the Man in Charge of the Modern Shop.

Editor American Machinist:

So much has been written about new tools and fixtures, toolroom management, high-speed steels and many other things which enter into the make-up of the modern machine shop, and so little about the most important thing of all, the management of the shop, that it seems to me a few words in the way of suggestions for the man who has the full charge of the establishment would not be out of place.

One of the first things he should settle in his own mind, if he has ambitions to build up a well-ordered organization, is that the less information in regard to sizes, kinds of material, etc., he keeps stored up in himself, the better for him and for the shop. The drawing-room is the place to keep sizes, etc.

Let him give the men under him all the responsibility possible; it will leave his mind clearer for more important duties, and it will also do the others good. To illustrate: The superintendent of an adjoining establishment employing one hundred men or more was at our place on very important business not long ago. He had to be excused for a few moments to answer a telephone call from his factory. The question was: "Mr. ——, a little boy has come in with a tin pail and wants to know if he can fill it at our water faucet, as their water pipes have frozen up." The answer was: "Let him have the pail of water." This was a very good man, and he would not refuse anyone a pail of water while he had it to spare; but why did he not give his bookkeeper or assistant, or whoever it was, the privilege of giving it, without taking his time to answer the telephone?

The ideal superintendent should come in in the mornings looking cheerful, say "Good morning" to whomsoever he may meet, helper or owner. He should insist that everyone should be in on time, unless hindered by some unforeseen circumstance, and such circumstance should not occur often with the same man. He should be in on time himself. If he is going to be late, let him be late an hour or more. It looks bad to see him come along from seven to fifteen minutes after the other men are supposed to be at work. It shows a bad example, and to me it looks as if he lacks vitality if he cannot do what he requires his men to do.

Give a man a job and keep away from him until he either finishes or spoils it, unless he asks for help or information. If when a planer hand should have a valuable piece of work strapped on his planer table and under a very heavy feed something gives way, and the full contents of the table are pushed over the end on to the floor as you go by, don't stop and look at him or the *debris* on the floor; for if you are a mechanic yourself you most likely know by the sound of things what has happened. And if you are any student of human nature you know that the planer hand feels as badly as he ought to; and also that he will make a more intelligent job of gathering up the fragments if no one is around. Don't blame him for the accident. It was your own fault; he was taking too heavy a feed, for he knew you liked coarse feeds.

If you select a man to look after a department, give him all the orders intended for that department. Let him manage it in his own way. If he does not do it satisfactorily, don't give orders over his head, but get someone qualified for the position.

If the work does not come fast enough, do not look displeased and say nothing, but express your views freely on the subject to the one responsible.

Never get out of temper. If troubles arise so often that it looks as if you would never have things going right, just keep cool and work away, and if you work in the right direction the troubles will soon disappear.

Manage the shop as nearly as possible according to the ideas of the man who owns it, for it is his shop and he pays the bills.

Always have the interests of the shop uppermost in your mind; because that is where you earn your daily bread, and upon the success of the shop depends the happiness of others.

By all means lose your own personality (if it is necessary) for the good of the shop. If you invent an appliance, tool or anything, and one of your helpers suggests something better, use his idea and let yours go. Some will say this is no new idea. I know it is not, but it is something new to find a man who will do it. If you have a man whose personal convictions in regard to methods are so pronounced that he is continually opposing the way laid out by the management (altho probably not openly), drop him out at once, for such men (and, fortunately, not many of them survive) very rarely become willing

to co-operate cheerfully with improvements, and for that reason their usefulness is greatly impaired. Such men, if good mechanics, are likely to do much better in another shop where they are not acquainted, and are more likely to work according to instructions.

There is no place in the modern machine shop for a man who likes himself and his own ideas better than the success of the establishment of which he is a part.

If any of your men are sick, either visit them or have someone else do so. If they are genuinely sick they will be glad to see you, and if they are not, you ought to know it. Sick people ought to be visited and it is just as fitting that you should visit your "shop family" as that the church should visit its members.

Richmond Vial said, "If your belt needs fixing, fix it." That saying has helped many a man to be prompt in repairing things which needed attention, and that same spirit carried through in everything, made the establishment of which he was an important factor what it is to-day, the foremost of its kind in the world.

Considering the qualifications which go to make the man successful in this line of

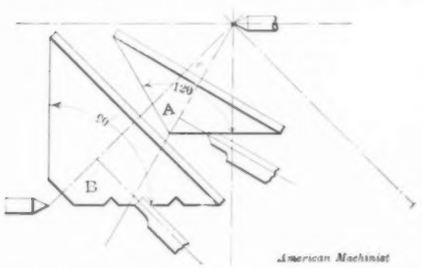


FIG. 1. SETTING TOOLS FOR THREADING TAPER WORK.

work (and I suppose it is true in most all lines), I think there are two which are far more important than all others, and they are the two possessed by the least number of people. The first is generally known as "push," and the second is, losing your personality for the good of the organization.

If an order is laid on your desk, no not leave it there until you are tired looking at it, and it probably gets thrown in the waste basket, but attend to it immediately.

If a man shows you where by taking off a little from a pattern, which would probably require a little of your energy to look into the case and a few minutes of the patternmaker's time, you could save two or three hours' time on each machine, do not lazily say, "Let it go for this time and we will look into it later," but go at once and have it attended to, and the next time it is needed it will surely be all right.

And in regard to the second qualification, do not be afraid your dignity will suffer and that your ability to manage the shop will be impaired, if it becomes known that your ideas have been set aside for those of someone else with your consent.

C. M. C.

The Setting of Threading Tools for Taper Work.

Editor American Machinist:

At page 431 you say, in relation to the setting of the tool for threading taper work: "We have always maintained that the proper thing is to set the tool square with the center line, whether the work is straight or taper, and upon consulting the Pratt & Whitney Company we have a letter from Mr. Eccles, the manager of its small tool department, in which he takes this view," etc. Mr. Eccles states one imperfection in the method and one reason why he considers it the better way, and you another reason why it should be "generally adhered to," viz.: "For the sake of uniformity."

I think that more weighty and logical reasons must be advanced before the "square with the surface" tool setters abandon their practise, because more uniformity now results from their method than from the other; that is, so far as uniformity of product resulting from tool setting is concerned.

An excellent way to test the two methods is by threading work of varying tapers by each method and then comparing results; and by way of carrying the matter to extremes, so that the true inwardness of the methods may be more clearly discerned, we may select the curved surface of a cylinder as the minimum possible taper, and its flat end surface as the maximum possible taper. Of course, strictly speaking, neither surface is tapering in even the slightest degree, but as both differ but infinitesimally therefrom, they will be good enough tapers for illustrative purposes. After so threading the said cylindrical surface we will find that both methods of tool setting produce identically the same result, showing that at this extreme the methods are equally good; but when we attempt to thread the flat end surface by your method of setting the tool the result is an absolute failure. As a matter of fact, your method fails long before this extreme is reached, for if the thread required be the regular 60-degree V, then a cone the apex angle of which is 120 degrees will be, as shown by *A*, Fig. 1, the threading limit; but if the regular proportioned square one be desired, then such limiting apex angle is but 90 degrees, at which angle the thread changes from a long and short sided square thread to a nondescript V, as shown by *B*, Fig. 1. Just where the "uniformity" from the use of this method comes in I have as yet failed to see, as the threads produced thereby on the many different tapers (that is, whenever you can cut a thread) are a sorry looking lot. It needs no diagram, however, to show that at and between both extremes substantially perfect symmetrical threads will be produced by the "square with the surface" setting.

The taper of the pipe is so near that extreme where either method of setting the tool produces the same result that the AMERICAN MACHINIST-Pratt & Whitney Company method may be thought good enough by many for that particular purpose, but believing as I do that any method that is right at one extreme and so radically wrong at the other must, consequently, be more or less bad at all points between, I am forced to believe that when the said company adopted the "square with the center line" thread for pipe taps, dies, gages, etc., somebody made a mistake, more particularly in calling it the "Briggs standard."

In view of the fact that for about a dozen years I was quite thoroughly schooled in things mechanical at the works of the Pratt & Whitney Company, and of the further fact that I have been a constant reader of your paper ever since it first started, and therefore perhaps ought not now to question anything set forth by either it or you, this criticism will probably be considered rank heresy; but as we cannot always believe everything that we ought to believe and often think that what is Gospel truth is just the opposite, notwithstanding most of us in our younger days have either read or been told what

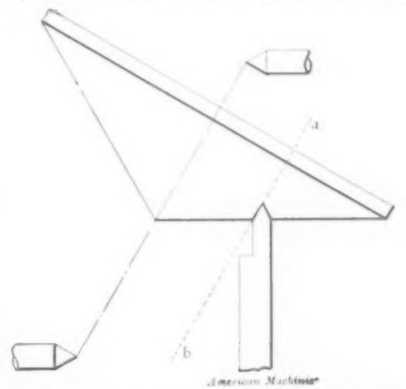


FIG. 2. SETTING TOOLS FOR THREADING TAPER WORK.

becomes of the unbeliever, I trust that you will now act the part of the good missionary and endeavor to convert the doubting old "has-been" by informing him as to what evidence there is that is now obtainable that proves conclusively that the late Robert Briggs ever located the thread on the tapering end of pipes, taps, etc., in the manner you say is now "evidently the practise."

Whatever the "practise" may be in relation to cutting the pipe-tap threads, be it right or wrong, the "square with the center line" method is not of general application for threads on all tapers; therefore, knowing "where we are at," is it the "proper thing" to try to do what can't be done?

CHAS. E. CHURCH.

Norwalk, Conn.

[We have drawn Fig. 2 to show that by applying Mr. Church's method of analysis it is as easy to show that the square-with-the-surface method is wrong. Here it is seen that a thread cut on such a taper as is specified in his Fig. 1 at *A* and with the tool set square with the surface, will have no holding power whatever, but that one

threaded piece will pull away from the other as readily as tho no threads were cut. This follows from the fact that the side of the thread represented by the dotted line *a b* is parallel with the center line of the work. Now, such a thread, being of no account whatever as a thread for fastening things—such as steam pipes —together, it must be evident that this thread is "more or less bad at all points between" this angle and the cylindrical thread. Most threaded pieces, whether taper or straight, are made to hold things together—*i. e.*, to resist stresses applied in the direction of the axis of the threaded pieces, and, this being true, we believe that the angular surfaces of the threads should be the same with respect to the direction of these stresses throughout the series instead of constantly approaching the condition of Fig. 2. We think, therefore, that whether Mr. Briggs designed his threads to be square with the axis of the pipe or not, he ought to have done so, and that that setting of the tool is the best, is correct and ought to be adhered to by everyone who threads a taper piece for the ordinary purpose of threaded work.—Ed.]

A Manufacturer's "Conservatism."

Editor American Machinist:

Mr. John Randol's article at page 379 recalls to my mind a little experience which I had with a well-known firm with a specialty of making machinist tools. I had an idea that a certain tool, that I will call a center punch, made by this firm if somewhat altered would be not only increased in worth but would also have its life or endurance extended threefold. Having demonstrated to my own mind its usefulness, I decided to impart my knowledge to the manufacturer. No sooner said than done; so forthwith I sent him my center punch with a letter explaining its merit. In a few days I received an answer signed by the president of the firm and also a check for a small amount as a recompense for calling his attention to something which he considered of interest. The letter follows:

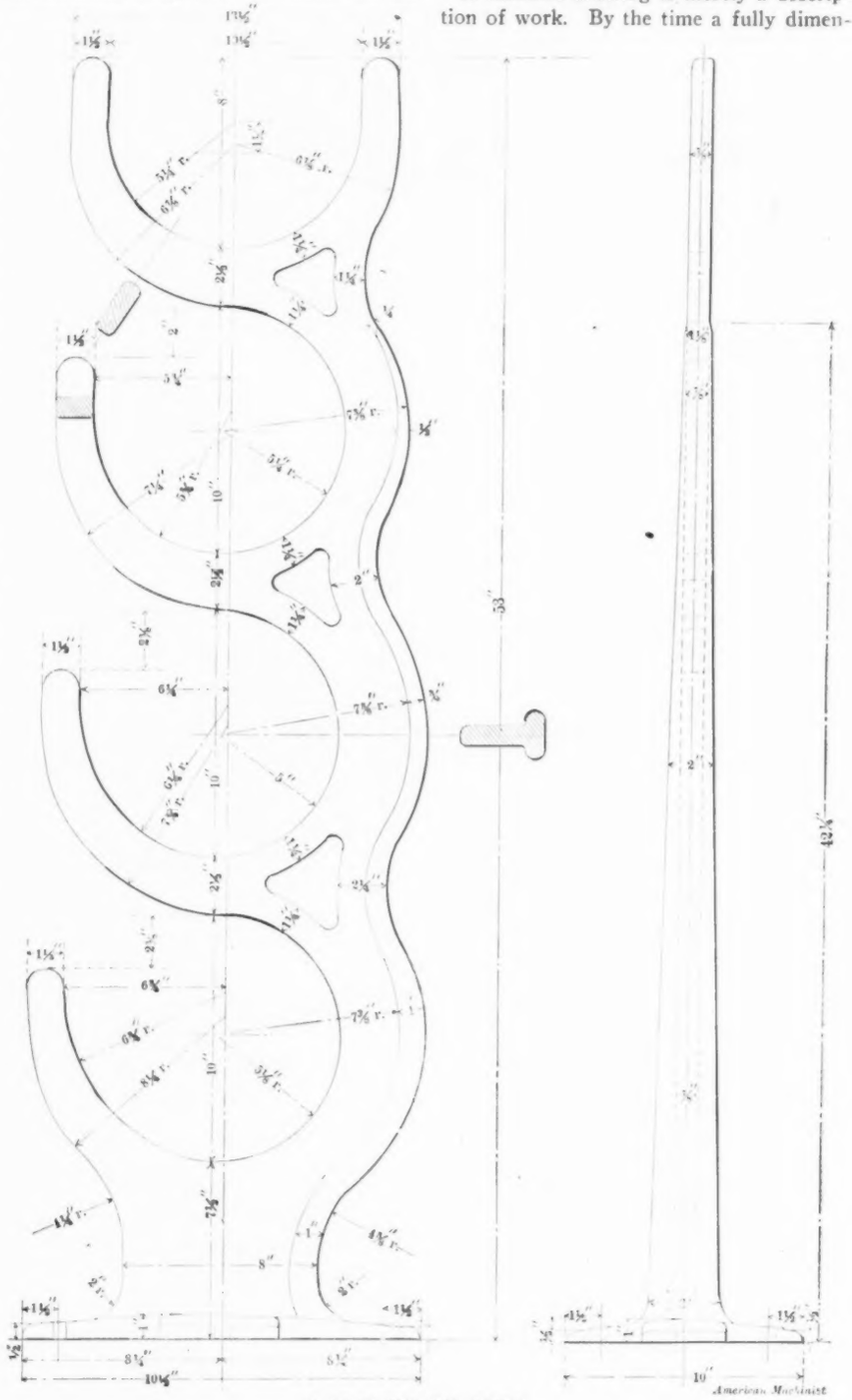
"Dear Sir: We are in receipt of your letter and of your center punch. We have examined it carefully, and altho we admit that it is all that you claimed for it, and that it will practically outwear three of our center punches of standard make, we nevertheless question the advisability of making them as per your sample for the following reason. With us it is as it is with boot and shoe manufacturers—that is to say, were we to supply the consumer with an article that would practically not wear out, after the trade was once supplied there would be no more demand; consequently it is not always the best policy, from the manufacturer's point of view, to put the best article on the market."

This letter, which I still possess, I received two years ago. Evidently the manufacturer has not changed his mind up to date, for in looking over his latest catalog I find that he still manufactures an article that will not last too long. SCRIBLETS.

A Rack for Bar Stock.

Editor American Machinist:

The storing of bar stock is a subject that has to be considered some time or other in nearly every shop, and the accompanying illustration shows a rack designed for this purpose. The center of gravity of the load being over the center of the base, makes it very stable, even when not screwed to the floor. The castings are light enough to be easily handled and may be set near a lathe to hold shafts being turned. In the stockroom they may be placed back to back or used singly in rows, as desired.



A RACK FOR BAR STOCK.

By following the dimensions given any patternmaker can make the pattern from which the required number of castings may be made. No machine work is necessary, all holes being cored. S. BLISS.

Scale Drawings

Editor American Machinist:

A machine drawing is merely a description of work. By the time a fully dimensioned drawing reaches the shop the scale to which it is made is of little importance, but in its earlier days its scale may be called the language of its description. The ideal drawing is natural size, but a de-

signer is frequently compelled to put ideas of large machines on small pieces of paper. A scale may be learnt. In the eye of an experienced draftsman a drawing made, say, quarter size may be thoroughly understood—that is, the spaces between the lines instantly converted into matter of a certain size.

The draftsman, however, must convey to others as well as to himself a notion of the work as it will be when finished. His superiors and perhaps their customers may wish to study designs before they are proceeded with, and it is chiefly for such men that the draftsman should prepare a key for translating his drawing.

Scale drawings are at the best of times deceptive probably because we are all so apt to forget that a machine when finished is not a flat surface, but its whole cubical measurement is multiplied according to the scale of the drawing from which it is made. A mere statement of scale is insufficient to explain a drawing to anyone but an expert. To help matters, all general arrangements drawn half or quarter size should have one-foot or two-foot rules to scale in positions on the drawing where they may be easily seen. Those made ⅛, 1-10, 1-12, 1-16, 1-24, 1-32 sizes, etc., should have an averaged sized man drawn for comparison. If this, in the opinion of the designer, spoils the appearance of the drawing, a paper man cut out to correct scale may be placed upon the drawing when it is desired to compare the design with its finished size. Paper men cut out to the usual scales may be kept for office use; if they are in frequent use they should be made from metal or celluloid. This trick is old, but is by no means so well known as it should be. R. D. S.

Birmingham, England.

Local Case-Hardening.

Editor American Machinist:

It sometimes happens that only certain parts of a piece are wanted hardened, whether for wear with different materials or because it is desired to drill or further work up particular features. In such cases it is convenient to be able to case-harden just so much of the piece as may be desired. The trick of doing this was well known years ago, but had passed out of memory pretty generally until the bicycle business developed so enormously a few years ago, when it was revived in connection with the manufacture of parts. The trick is very simple, and can be readily done in almost any shop. It is only necessary to cover the spots or places which it is wished to keep soft, with a thin coating of copper. Carbon does not penetrate copper, and as the process of case-hardening is only one of carbonizing the surface of iron it follows that a deposit of copper will preserve the part under it from the hardening effect.

A good way to apply the copper is by means of the electrolytic bath. A bath of copper sulphate is prepared, in which the piece to be treated is suspended from the negative pole of an electric battery, opposite a sheet of copper suspended from the positive pole. After a sufficient thickness has been deposited, the copper may be buffed from the parts which are to be hardened. Or, as is usually more convenient, the part to be hardened is coated with wax or some easily removed varnish, and then placed in the bath, the wax or varnish being afterward removed by heating or otherwise. No copper will be deposited except where the metal has been exposed to the action of the bath. O. M. B.

Facing to a Radius.

Editor American Machinist:

The casting shown in Fig. 1 is required to be turned up smooth all over the outside, and to have the hub bored, faced and threaded in the inside. The sweep of 20 inches radius was done by the method shown in Fig. 2. The pieces had been chucked and the hole in the inside bored, faced and threaded and the face *a* trued up at one chucking, when they were rechucked for doing the whole of the outside, as shown in Fig. 2. The plate *b* is of cast iron, bolted fast to lathe face-plate, faced and turned up ½ inch less in diameter than the finished pieces had to be, and threaded in the center for the steel mandrel *c* which is screwed tight in the plate. The other end of this mandrel is threaded to suit the work, which is screwed on, the face *a* bedding close against the plate *b*.

The circumference is turned to 20 inches diameter, and the end is faced to the proper radius by the use of the former *d*, which is made of cast iron and bolted to an angle-plate fixed on the lathe bed, as shown. The screw is taken out of the top slide of the compound rest and the holder and roller *e* are fastened on. The lathe carriage is locked, the cross-traverse put in, and the cut, which is put on by moving the tool, keeps the roller *e* pressed up close to the former.

The clamps shown in Fig. 3 are lined with leather and are used for releasing the work from the mandrel. When finished, a sharp blow with a lead hammer in the direction of the arrow is sufficient to release it. The hoist is then hooked in the bale *f*, the lathe is run back and the piece is finished. J. WHEELER.

Newport, England.

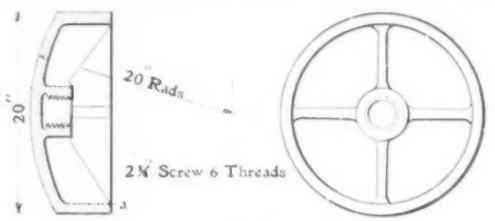
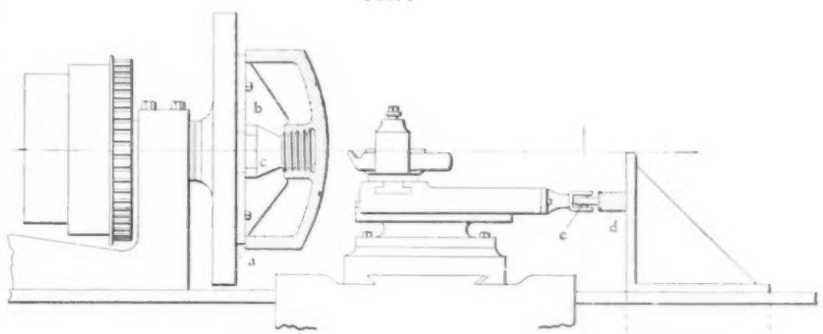


FIG. 1



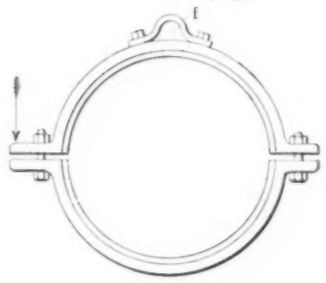


FIG. 3

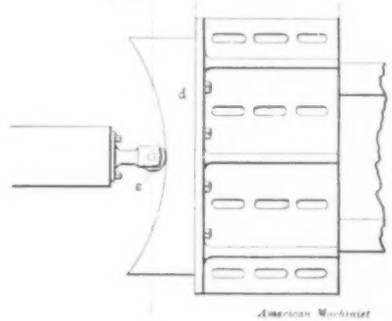


FIG. 2

FACING TO A RADIUS.

High-Speed Machine Tools.

Editor American Machinist:

In view of the high-speed advertising now so much in vogue, would it not be well for machine builders to specify the tensile strength of the material worked and the cubic inches removed per minute per horse-power delivered to the machine?

Such a statement would enable the buyer to judge of the metal-removing abilities of any two machines instantly.

CHARLES H. MCCLELLAN.

An English Design of High-Speed Lathe.

Editor American Machinist:

In reference to your description and illustrations of an English high-speed lathe at page 312, I wish to draw your attention to a few points.

You will notice on glancing through the tables of speeds, gears and cone pulleys that the maximum gear ratios of these lathes are as follows: 9 inches center, 22.7 to 1; 10 inches center, 29.8 to 1; 12 inches center, 20 to 1; 18 inches center, 22.5 to 1, and 24 inches center, 30 to 1. On consideration of these figures there does not appear to be the slightest attempt at uniformity of design in the arrangements of these gear ratios, and the reason for the erratic fluctuation of these values requires not a little understanding. Arranging the lathes in order of their gear power, the result would be as follows: 12 inches, 20 to 1; 18 inches, 22.5 to 1; 9 inches, 22.7 to 1; 10 inches, 29.8 to 1; 24 inches, 30 to 1.

Hight of Centers	6″	7″	8″	8½″	9″	10″	10¼″	12″	13″	13¼″	14″	15″	16″	16¼″	18″	24″
Maker.																
A	.	.	.	.	817	1743	.	1800	.	.	.	.	.	.	3510	6300
B	.	.	.	.	.	.	1496	.	.	2280	.	.	.	3240	.	.
C	.	.	.	.	.	.	.	420	.	.	.	.	2176	.	.	.
D	.	.	.	.	.	.	.	.	1608	.	.	6528	.	.	.	3150
E	.	.	.	324	.	677	.	896	.	.	.	.	2815	.	3134	.
F	.	.	.	.	.	.	.	1386	.	.	.	.	.	.	.	.
G	.	.	.	.	.	.	.	744	.	.	.	.	.	.	3351	.
H	260	318	616	.	.	980	.	1512	.	.	2000	.	.	.	.	39424
I	.	.	.	.	.	2244	.	3182	.	.	4284	.	5548	.	.	.
J	.	.	.	.	.	17952	.	25459	.	.	34272	.	44390	.	.	.
K	.	.	.	.	.	.	.	708	.	.	.	.	.	.	.	.
L	.	.	.	.	.	.	.	1166	.	.	.	.	.	.	.	.
M	.	.	.	.	.	.	.	1687	.	.	.	.	.	.	.	.
N	.	.	.	.	.	.	.	750	.	.	.	.	.	.	6120	.
O	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	34560

TABLE 1. COMPARATIVE DRIVING POWER OF DIFFERENT MAKES OF LATHES.

Again, according to the tables, the 9-inch lathe is arranged to deal with diameters up to 30.4 inches, the 10-inch up to 50 inches, the 12-inch up to 26 inches, the 18-inch up to 28.2 inches, and the 24-inch up to 70.5 inches. Dividing these diameters by the hight of centers for the sake of comparison, we arrive at the following results: 9 inches center, $\frac{30.4}{9} = 3.37$; 10 inches center, $\frac{50}{10} = 5$; 12 inches center, $\frac{26}{12} = 2.16$; 18 inches center, $\frac{28.2}{18} = 1.56$; 24 inches center, $\frac{70.5}{24} = 2.93$. A curve plotted from these figures might form a good illustration of the fluctuation in the price of cotton, but certainly not an example of the best modern machine-tool design.

While I agree with you that the speeds are closely in accordance with geometrical progression now so much in vogue, I am of the opinion that they might have been arranged much nearer than they are, as I find in going through the speeds for the 9-inch lathe that there is a drop from one speed to the next lower of 23.5 per cent. as a maximum and 16.8 per cent. as a minimum. I also notice that the 10-inch lathe cone pulley is run at the high speed of 1,218 revolutions per minute and, while not questioning this in any way, I should be pleased to know how it works out in practise.

A suggestion has been made for comparing tools of different sizes and makes from the standpoint of driving power, and I have compiled the accompanying Table 1 from various sources for lathes of various makes and sizes. The figures in the body of the table are obtained by multiplying the diameter of the largest pulley by the width of the belt and this product by the maximum gear ratio. The table is rather incomplete, but the figures given will be sufficient to enable your readers to judge of the enormous differences in the power of machine tools as built by different makers. The particular lathes previously referred to are embodied in this table under the heading A. A. W.

Manchester, England.

[The figures given by our correspondent for the departure of the speeds from true geometrical progression, by looking at the matter from the standpoint of difference of speeds instead of ratio of speeds, appear to give a larger discrepancy than really exists. The discrepancy between 16.8 and 23.5 per cent. difference of speeds appears at first sight to be a larger factor than that between 76.5 and 83.2 per cent. ratio of speeds, altho it is really the same. We have calculated the speeds for a true geometrical ratio as applied to the 9-inch lathe and give the results, together with the true speeds, in Table 2, from which it will be seen that the discrepancies are unimportant. It is of course impossible to obtain absolute accuracy in these matters, owing to the necessity for using integral numbers of teeth. The considerable use of prime numbers of teeth in the gears of these lathes, in one case as large as 103, would indicate that the most careful study has been given to the matter. The slight discrepancy shown in Table 2 at the highest speed represents, of course, the accumulated error of the multiplications.—Ed.]

Calculated Speeds,	8 8	11.1	14.1	17.8	22 5	28 4	35 9	45.3
Actual Speeds,	8.8	11.4	14	18.3	22	28 6	35.2	45.8
Calculated Speeds,	57.3	72.4	91.5	115.7	146.4	184.4	233.1	294.7
Actual Speeds,	57	74	91	118	142	185	228	295

TABLE 2. ACTUAL AND CALCULATED REVOLUTIONS PER MINUTE OF 9-INCH LATHE.

A Primitive Electric Light Exhibition.

Editor American Machinist

The following experience was recalled by reading one of Mr. Chas. T. Porter's most interesting "Engineering Reminiscences."

In the year 1882, having an engagement with the Edison Company of Great Britain, a company then young, I was detailed to run down to Plymouth, England, to exhibit the new and marvelous Edison light. A large flower exhibition was being held in a huge tent or marquee in the courtyard of the "Guildhall," *i. e.*, the public buildings, etc., of Plymouth. I had just a couple of days' notice, and was informed I could easily hire an engine for the purpose of driving our Edison dynamo, old-fashioned Z type. On arrival I found, however, that nothing was to be had except an Aveling steam roller (same as mentioned by Mr. Porter in his admirable article) belonging to the corporation of Plymouth. As nothing else was to be had, we did our best with that, and with excellent results.

Firstly, the heavy front wheels, being used for both steering and rolling, were taken off; the boiler having been jacked up and a timber foundation built to take their place. This had to be done to enable the belt to run from the flywheel of the engine (which rested on the top of the boiler on saddles) to the pulley of the dynamo.

The engine flywheel was 4½ inches wide, and the belt of the dynamo, which I had brought along, was 6 inches; however, no matter, I simply had to use it. The centrifugal ball governor was cut out, the driving mechanism was thrown out of gear and the speed of the engine regulated at the throttle until the required speed of 1,200 revolutions per minute on dynamo shaft was obtained. The pressure carried was 100 pounds per square inch and it did not, with judicious firing, vary 1 pound during the two nights' run.

I may add that as the dynamo did not arrive till about 30 minutes before the show opened some lively hustling had to be done. The wiring was of course already done, but the old-time Edison Z machine always had to be erected on the spot, and was, as we all know, an ungainly affair of about 60 inches in hight and weighing about 30 hundredweight. Ammeter and voltmeter we had none, these being in

those days an expensive luxury, and a man that could not run his lamps to 16 candle-power and keep them there with his pilot lamp alone for a guide was not much thought of. OLD TIMER.

Silver Circles for Astronomical and Surveying Instruments.

Editor American Machinist:

In the case of a circle having the silver *a*, Fig. 1, on a bevel, both edges being exposed and the graduations on the upper edge to match the vernier *b*, the brass casting should be wider than the finished size to permit dovetailing and hammering the silver in place in the manner shown at page 261 before soldering. After the silver is let in, turn away the brass on the top edge when the silver will lift out, and the bottom edge should be turned away and the circle be tinned for soldering. Carefully file the ends of the silver strip, taking off as little as possible, and see that the ends fit against each other when they will be ready to be hard or silver soldered together. Bind the ends together with wire, clean the strip carefully near the joint and solder them together, using borax for a flux and taking care not to melt the silver. Tin the inside and place on the circle ready for soldering in place. With a clamping piece *a*, Fig. 2, and a ½-inch bolt bind the parts together; heat them in a Bunsen burner and, when the solder runs, tighten the bolt a little more until the silver fits neatly. If salts have been used for a flux, use plenty of resin. The clamping piece *a*, having spokes, the inner edge may be easily reached. When cold remove the clamp and the parts will be ready for turning. When there are many circles of one size to be made, it is better to make a steel templet or jig in two parts and of the exact size of the circle into which the silver can be hammered. Some men do not bother to shape the silver either in a jig or in the circle, but simply measure the diameter in the center of the bevel, multiply it by 3.14, then cut the silver to the given length, hard solder the ends and use the clamping piece to bring it to shape. Some get to be quite expert at this method, but only occasionally do they get the silver to fit as neatly as by the other methods.

To silver a circle on the edge as shown in Fig. 3, first measure the circumference of the circle carefully, cut a strip of silver to this exact length and 1-32 inch wider than the edge of the circle. Soften the silver and with two or more pieces of wire bind it to the circle, allowing a space of 1-64 inch when the silver is tight on the circle. Take the silver off the circle, make a neat joint and hard solder the ends together. Tin the inside of the silver and the rim of the circle. It will require a bit of care to get the silver on the circle without bulging it, but it can be easily pressed on, as a rule, though sometimes a light mallet will be required to tap it on, care being used not to give it one more blow than is absolutely necessary. To solder parts together, *heat the circle in the middle first*, so as to make it expand as much as possible, for, if heated on the edge first, the silver will expand the most and leave a gap.

To silver a circle with the silver on the circle flush with that on the vernier, as shown in Fig. 4, groove or dovetail the circle as shown at *a*, and with a three-cornered file cut notches in the groove, as indicated by the zigzag line, cutting through the inner edge but being careful not to injure the outer edge, and tin the groove for soldering. Proceed as though the silver was to be dovetailed in, but with the addition of tinning the inside. Hammer it in as described in the preceding article and then solder it in place, the notches that have been filed in permitting the solder to run more readily. When cold turn away the inner edge of the brass, being extremely careful not to start the silver which will follow the use of a blunt tool.

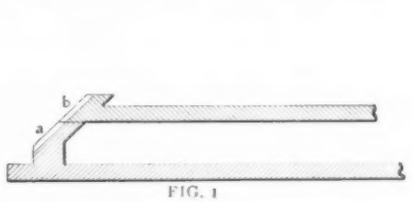


FIG. 1

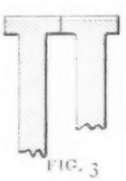
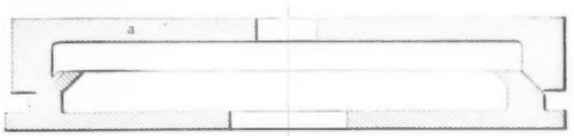


FIG. 3



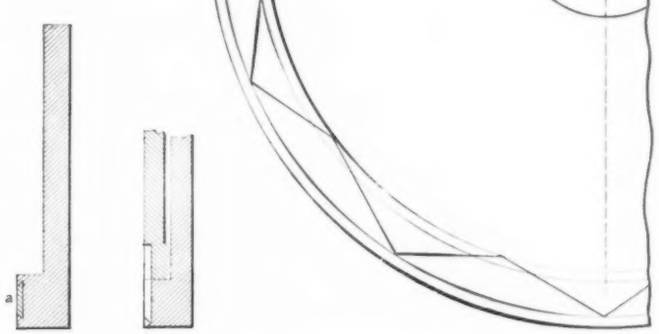


FIG. 4.

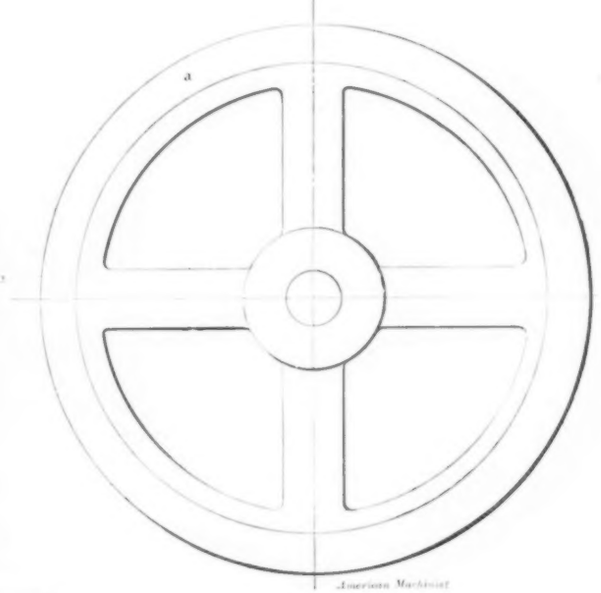


FIG. 2.

SILVERING CIRCLES.

The verniers, in nearly all cases, are graduated on narrow arms to which fixing the silver is a very simple matter.

York, England. Y. K.

Annihilating Impossibilities.

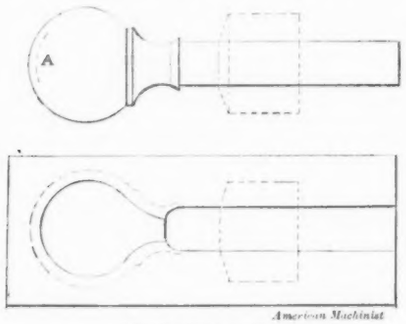
Editor American Machinist:

I remember hearing my father—who died six years ago, aged eighty-three years—relate that when he was a boy, in a strife with his mates as to who could tell the biggest and most improbable yarn, he took the prize because he proposed to "bottle up the power of Niagara Falls and ship the bottles all over the world!" precisely what is being done to-day. How many Quixotic dreams of to-day may become the accomplished realities of to-morrow! J. E. WILSON.

Long Stem Cores.

Editor American Machinist:

In regard to the letter about long stem cores, by "Homo," at page 421, I approve of long cores, but in this case I think if the corebox were made as per sketch enclosed (dotted line) you would find that the



LONG STEM CORES.

core would be better balanced and have an exact wall of metal, as the molder could not place the core in wrong. "Homo's" way of molding is apt to make the end of the knob at *A* of various thicknesses, as the molder could place the core farther in or out, the end of the coreprint being a very uncertain line to set the core by.

J. F. P.

Business Literature Abroad.

Editor American Machinist:

An American firm sends me eleven circulars, all different in color and contents, file and index all these. Well, I won't. Most of them get scrap-basketed.

One firm sends me *Spanish* circulars for Germany! ROBERT GRIMSHAW.

Hannover.

Draftsmen's Scales.

Editor American Machinist:

Allow me to add to what has been said at pages 318 and 357 regarding draftsmen's scales.

It seems remarkable that the scales as ordinarily manufactured and sold to engineering students are quite well adapted to the requirements of architects and to some engineering work, but when it comes to the readers of the AMERICAN MACHINIST there is the staple article graduated as mentioned by Mr. Lyne to ⅛, ¼, ⅜, ¾, ½, 1, 1½ and 3 inches to the foot, and if we do not find what we want in the list we are invited to determine what we require, make a sketch of it, wait a week or so, pay an extra price, pay the freight (or expressage), and possibly at the end of all this discover that we did not know just what was required of a mechanical draftsman.

The objects which an architect represents on his drawings are, roughly, about twelve times as large as those which the machine draftsman wishes to represent, so that while the one finds it proper to use scales of ¼, ⅜ and ½ inch to the foot, the other would like ¼, ⅜ and ½ inch to the inch, but, as he has no such scale, he uses instead of quarter size 3 inches to the foot and for half size he may be fortunate enough to have a half-size scale graduated full length, but more often he uses a full-size scale and divides each dimension by 2, while he would never think of using such an odd scale as ⅜ size.

The scales, full, half and quarter size, are used on drawings of medium-sized machinery almost exclusively. To have these three scales together on one stick, and to have each one divided into whole inches and sixteenths is certainly a great help in avoiding blunders and confusion. When working half size, for example, the quarter-size scale, if convenient, may be used for radii of circles and to set off distances each way from center lines. In using scales in this way a man only thinks of one number in connection with each dimension instead of reasoning that $3\frac{1}{8}$ is $1\frac{7}{16}$, which is $\frac{5}{64}$ radius. Half a minute later this dimension would probably be written $2\frac{7}{16}$ if the average draftsman trusted to his memory for it.

The objection to having two scales on one edge is most noticeable with the beginner or with the man who is unfamiliar with the tool. This trouble disappeared with me in a month or two. The other objection to having two scales on each edge which makes it necessary to clear away a pile of rubbish before making a measurement will not disappear in so short a time, and when this trouble is likely to occur one may either use one scale on each corner, or use a shorter one.

For my own use, I have a scale 10 inches long graduated as shown in the accompanying Figs. 1 and 2, and another scale graduated in a similar way which is 12

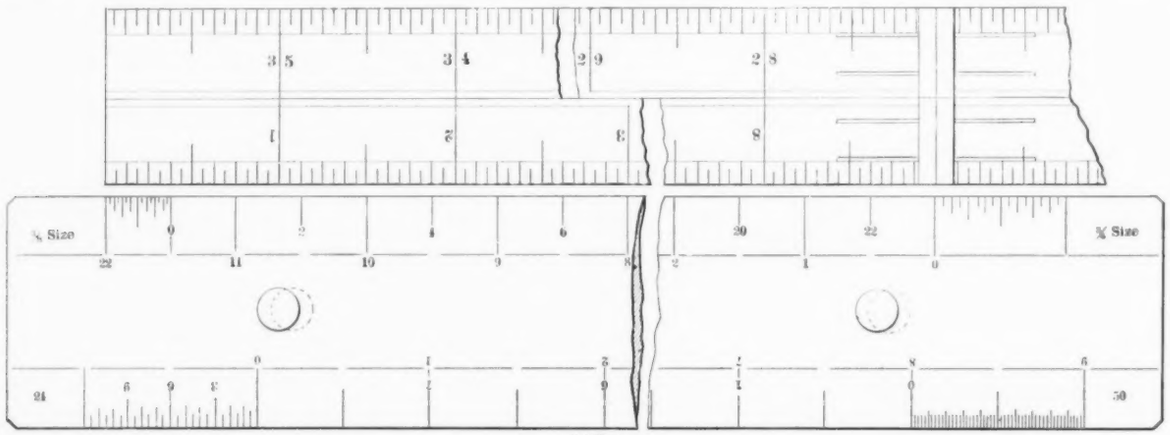


FIG. 1

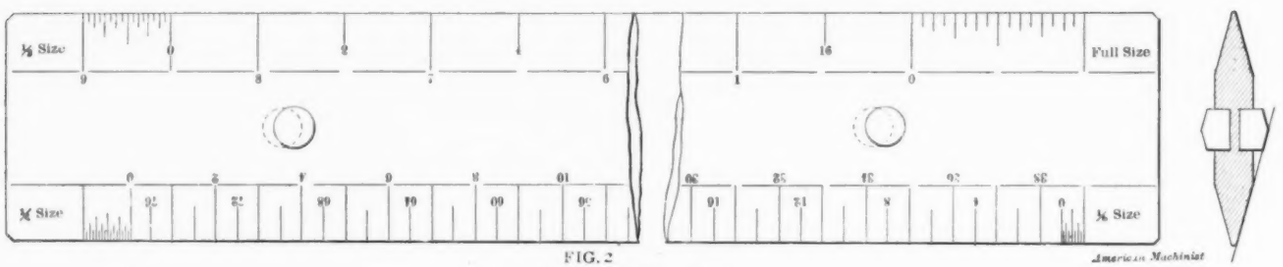


FIG. 2

DRAFTSMEN'S SCALES.

and of nine different sizes when folded. Some open on the side, some on the top; some are printed the "wide" way and some the narrow way. I'm expected to inches long. The flat, double beveled, white edge scale is preferred, and I have found a manufacturer in Philadelphia who makes them in such a thorough manner that they

keep straight and true. The cork plugs cemented in with shellac for keeping the edges down to the paper are a recent improvement, which is all right, not patented, and worth trying. Basswood plugs glued in place will answer the same purpose.

Now, Mr. Editor, I want you to tell the draftsmen that the scales ⅛ and ¾ size *are not* freak scales any more than ⅜ and ¼-inch-to-the-foot are. And if you will just illustrate a common 15-cent 36-inch Yankee rule alongside of Fig. 1 every machinist will see at a glance that ¾-size drawings *can be measured* all right, and that all that is necessary when measuring is to read an inch where it measures ¾ and 4 inches for 3, and feet at the joints of the rule.

If boxwood scales were treated to a fresh coat of white shellac varnish about once a year, they would serve their purpose longer and better. R. ULE.

Editor American Machinist:

In all the discussion which has appeared regarding draftsmen's scales, there is one point in favor of triangular metal scales which has not been properly emphasized—*i. e.*, the facility and accuracy with which measurements may be laid off by running a needle point down the groove into the paper, as shown in the half-tone. Wooden or celluloid scales do not have grooves deep enough to guide a needle, hence the

THE USE OF THE METALLIC DRAFTSMAN'S SCALE.

dimensions must be laid off by making a mark on the paper as nearly as may be opposite the division on the scale. This is not a correct method, especially if one uses a lead pencil for laying off this work, because, before he is aware of it the pencil becomes dull and inaccurate. By running a needle along a steel scale until the proper division is reached, the mark will be felt rather than seen. The point will drop into the groove with a click and will then slide accurately into the paper. Thus the eyesight is relieved, the liability of error reduced and more accurate work done than with a wooden scale and a blunt-pointed pencil. W. H. S.

[This point was made by Mr. C. O. Griffin at page 357, but the accompanying ilustration serves to emphasize it, and we hope will call the attention of many draftsmen to it. Our own experience is of exactly the same kind. We do not see how anyone who has ever used a metallic scale with a prick point can ever go back to a flat scale and a lead pencil.—Ed.]

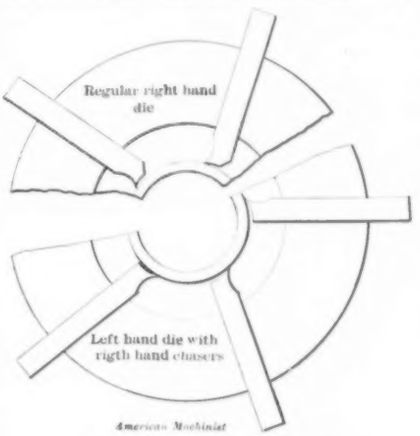
Making a Pipe-Threading Die Cut Clean.

Editor American Machinist:

Noticing Mr. Sargent's letter, at page 325, on threading seamless tubes, reminded me of our experience along the same lines. When we first began to use solid drawn steel tubes the job of cutting perfect threads on them caused a great deal of trouble and loss of material. We were using regular Saunders expanding dies, with the same chasers we had used for charcoal iron tubes. By flattening the points of the chasers and careful grinding we obtained fairly good results for a short time, but directly the dies were the least bit dull they would tear the threads out and ruin the work.

Having usually had perfect threads, we were not satisfied and decided to investigate. We found the cutting angle of the chasers very obtuse, with little or no top rake, as shown at the top in the sketch. This was the arrangement of the chasers in a "regular" right-hand expanding die, the front edge of the chasers being in a radial line and thus presenting a very poor cutting angle; in fact, the metal was torn off and not cut.

To overcome this, we ordered a left-hand die block fitted with right-hand chas-



GIVING RAKE TO THE CUTTERS.

ers. This arrangement placed the fronts of the chasers ⅛ inch in advance of the radial line and gave a very much better cutting angle, as is apparent in the lower part of the sketch. The result was most satisfactory, the cutting coming off in continuous shavings as from a well-ground lathe tool, the threads being perfectly smooth and true. A liberal supply of good lard oil is most essential for perfect screw cutting of any kind, and is doubly necessary for solid drawn steel tube.

Most of our threading is 1½- and 1¼-inch standard right- and left-hand pipe threads, absolutely perfect joints being necessary. Occasionally we have special threads requiring more careful treatment; for instance, cutting 18 threads to the inch on 1½-inch outside diameter No. 14 gage solid drawn tubes. The walls of these tubes were so thin that the dies pulled them out of round and cut through. A solid plug slipped inside the tube as a support secured perfect results.

Similar trouble was experienced in tapping open-hearth steel castings, and we found it necessary to have more cutting edges, with deeper flutes on the taps to give room for the cuttings, grinding the taps with as much top rake as possible. A stream of oil is necessary, as it washes the cuttings away and prevents their fouling and spoiling the threads. C. E. W.

Squaring Numbers Ending with 5 Mentally.

Editor American Machinist:

I have read with interest Mr. Bornholt's letter at page 529, showing how to square mentally a number ending with 5, and would like to say that the method I use, tho practically the same as Mr. Bornholt's, is yet, with one manipulation, shorter. I do not claim to be the originator of "my method." I think a gentleman by the name of Pythagoras discovered it a couple of

years ago, but it may have been forgotten by some of my fellow-draftsmen.

For example, take Mr. Bornholt's number, 65^2. Multiply 6 by the next highest number, 7, giving $6 \times 7 = 42$, and annex 25, giving 4225. Again take the number 135^2. $13 \times 14 = 182$, which with 25 annexed becomes 18225. I would not advise this method for numbers larger than 155^2, because it is quicker to find the answer in a table than to make two or more manipulations mentally. S. I. OESTENEICKER.

Calculations for Hydraulic Punching and Shearing Machines.

Editor American Machinist:

The most attractive feature of the article by Arthur H. Jackson, published at page 381, is his mention of the penetration of the tool and his calculation of the highest pressure on this basis. The shearing pressure of 202,600 pounds which he finds is, however, so low that it is necessary to carefully examine his results, and for this the recent tests and researches of Professor Codron, at Lille, afford an excellent opportunity.

The letter of William Sellers & Co., at page 886, Vol. 22, concerns particularly the amount of pressure required for punching 2-inch holes through 1 and 1½-inch plates and the tests show that the maximum pressure is reached when the tool has penetrated about one-third of the thickness of plate.

Several tests made by Professor Codron show that the maximum pressure can be reached at a penetration of .25 to .45 of the plate thickness. This coefficient n depends upon the material and is very low for tool and other high-carbon steel, but is near .45 for wrought iron of great ductility.

For soft steel n was about .38 of the plate thickness. In other tests made with soft steel the maximum pressure was reached at about .35 of the thickness and the following results were obtained for parallel blades, the width in all cases being 60 millimeters:

Thickness, mm.....	4	10	15	20
Max. pressure, lbs....	15,400	35,200	50,600	63,320

In relation to the sheared section .35 thickness × width = .35 $a \times b$, we have the stress per square inch:

Thickness, mm.....	4	10	15	20
Stress S, lbs.....	136,300	125,000	122,000	120,700

the stress being much higher than the tensile strength.

In relation to the full section $a \times b$, the stress S equals 40,800 to 36,000 pounds per square inch, the ratio between this and the tensile strength being about .8. When the blades have an angle of 8 to 12 degrees the required pressure is considerably less and the stroke is in proportion greater; but the tests show that the necessary pressure was higher than the pressure which Mr. Jackson gives for this kind of work. That Mr. Jackson had no trouble with his method can be understood, as all working parts in his machines are very strong and the stress moderate. In Professor Codron's tests the cutting of flat steel bars 6½x60 mm. and 6½x100 mm. with angular blades of 10 degrees developed a maximum pressure of 8,530 pounds with $n =$ about .25. In relation to the surface figured by Mr. Jackson which equals: penetration × cot. 10° × thickness of plate, or in this case .35 $a \times$ cot. 10° × a = .35 a^2 cot. 10°, we have S = 37,000 pounds per square inch. Another test with soft steel gave for thickness $a = 1$ inch a maximum pressure of 55,000 pounds, n = .36, and for the area .36 a^2 cot. 10° a stress of 58,000 pounds per square inch. All these tests were made on a testing machine adapted to this kind of work. Several other tests on a shearing machine with belt drive show differences in the unit of work per square millimeter. The required power was sometimes twice as great and the maximum pressure also was higher.

Professor Codron gives for the maximum pressure the formula $P = \frac{n a^2 S}{4 \sin \alpha}$ in which n is the coefficient of penetration, a the thickness of plate, S the stress per unit of area and α the angle between the shear blades. In some tests the calculated pressure P was only one-half of the pressure resulting from the actual registered diagrams. Remembering this, Professor Codron is of the opinion that in all calculations for this kind of machines the calculated pressure should be multiplied by 1.5 to 2 and more.

According to this, with the calculation of Mr. Jackson, we have the assumed highest pressure =

1½ × 202,600 = 304,000 pounds, nearly.

In my description of the machine I called attention especially to the fact that the slightest clearance between the shear blades can increase the amount of pressure more than 30 per cent. A clearance of 1-20 millimeter is unimportant for the slide guides, but is very important in relation to the blades, and when the machine is frequently in action we can expect the first excess in pressure on the shear side.

We can see further that the old Hartig formula, P = .55 a^2 cot. α S contains a high factor of safety for these machines. This formula is based on the supposition that in angular blades the full triangular section: ½ (thickness × thickness × cot. α) = ½ a^2 cot. α must be submitted to the extreme shearing stress until the rupture is complete. Professor Reuleaux recommends the use of the safety factor 1.1 in connection with the formula, and consequently we obtain the maximum pressure: $P = 1.1 \times \frac{1}{2} a^2 \cot. \alpha \times S = .55\, a^2 \cot. \alpha\, S$. For parallel blades the maximum pressure is $P = 1.1 \times$ thickness × width × S = 1.1 $a\, b\, S$.

This supposition is correct only in the shearing of cold rivets without special cutting edges on the dies in automatic cold rivet-forging machines. The complications in the actual shearing process are neglected in Hartig's and Reuleaux's formulas owing to the very limited experience and tests at that date.

In the use of Sellers' empirical formula W = 14,000 $d\, t^2$ for the work done, I acknowledge a regrettable mistake for which I beg to be excused by the readers, and I am grateful to Mr. Jackson for his correction. Substitution shows that the result is not 373,000 pounds, but 37,750 expressed in work units. I should have said: "Sellers' formula, W = 14,000 $d\, t^2$, gives for the maximum pressure supposed acting on two-thirds of the thickness and for 75 per cent. efficiency in this case P = 373,000 pounds."

Mr. Jackson assumes the punching pressure P = circumference of hole × thickness × tensile strength, in accordance with Sellers' experiments. Professor Codron found the ratio between the unit of resistance against punching and the tensile strength to be from .9 to .8 to 1, except that for thin sheets 1-16 to ⅛ inch thick this ratio was nearly 1. For heavy plates in several cases it was not more than .77. In a test made on a hydraulic punch for 2-inch holes in 1 5-16 inch steel the required pressure was 440,000 pounds. The tensile strength was 63,000 pounds and the shearing stress S = 53,300 pounds; consequently the ratio is .84. In some machine shops we find the rule: Pressure = circumference of hole × thickness × shearing stress, or P = area to be cut × S.

In the published hydraulic punch, assuming the ratio between S and the tensile strength to be .86 and S to equal 55,900 pounds, we have P = 350,600 pounds, differing slightly from the calculated pressure. The stress on the frame would be consequently 4,515 pounds instead of 5,250 pounds per square inch.

CHAS. HERZBERG.

Use of Photographs in the Design of Machinery.

Editor American Machinist:

In these days many manufacturers photograph all their special machinery. Here is a chance to assist the designer in his work. These prints are comparatively cheap and an album can be made up to include all these photographs. By properly grouping them under heads the designer can readily turn to the machine he is altering or redesigning. Thus many errors can be avoided.

Photographs of all new motor drives, special tools, etc., are of great value.

Nowadays rectilinear lenses are used in nearly all cameras and the photographers are so well versed in getting the best view of the machine that one can get a very good general proportion from these photographs. Thus all vertical lines are parallel; a straight front view will give parallel lines. As both of these conditions are common to many photographs, we can obtain a very fair idea of the proportional thickness of ribs, diameter of shafting,

etc., in comparison with a certain standard dimension.

Suppose we had a photograph of a punch, the hight from the floor line to the die would be known. By comparing this hight with the main gear or with the fly-wheel, we will readily obtain approximately the size of these. We may be required to furnish a machine to a customer who wishes the design carried out in accordance with a certain photograph or engraving. On this photograph there will be certain things the dimensions of which we know. Let us take a planing machine as an example: we would know that the distance from the floor line to the top of the table is 30 inches. We now take a slip of paper which has been trimmed straight on the edge, apply this edge of the paper to the photograph and mark off two points which represents 30 inches. If this distance is divided into three equal portions, each portion will represent 10 inches; if one of these portions is divided into 10 parts, each one of these parts will represent an inch. This can be done with a lead pencil in quite a short time. The scale is then cut from the rest of the paper and should be marked to suit the photograph or sketch for which it was made.

With this scale we can measure approximately the thickness of the table, the size of the upright, the hight of the cross-rail, the diameters of the pulleys, etc. Of course this will give only approximate dimensions, and in using this scale one must use his judgment, as all photographs are not straight front views.

If the machine is set at an angle so that we have both a front and an end view, one can obtain a fair idea of the proportions of parts with a pair of dividers, comparing the known distance with the required distance and getting the distance in terms of the proportion of one distance to the other.

There are cases where one is obliged to attach a steam engine to a tool and the type of engine may be specified. The builders of this particular engine may be unable to furnish blueprints showing the outline of the engine. A photograph would willingly be sent, and from this photograph one can obtain, from known dimensions, the relative location of the steam pipe, governor, exhaust connections, hight of the operating levers, space required for clutches, etc.

With all these advantages which are to be gained from the use of photographs, one would think that they would be more generally used. There isn't any doubt that much of the trouble in the shop would be greatly reduced by a free use of photographs in the engineering office and the drafting room.

FRANK B. KLEINHANS.

The Abandonment of the Wire and Sheet Metal Gages.

Editor American Machinist:

We note at page 496 a reference on "The Abandonment of Wire and Sheet Metal Gages." In connection with this, it may be of interest to some of your readers to know that the Thomson-Houston Company discarded gage numbers and adopted the decimal gage as far back as 1888, and the General Electric Company has always followed the same practice.

MARTIN P. RICE,
Publication Bureau, General Electric Company, Schenectady, N. Y.

Maintaining the Size of the Blank in Blanking Dies.

Editor American Machinist:

The method of making a die when it is important to maintain the exact size of the blank depends on the kind of metal that is to be punched through it. If the

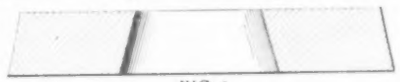


FIG. 1

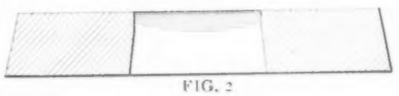


FIG. 2

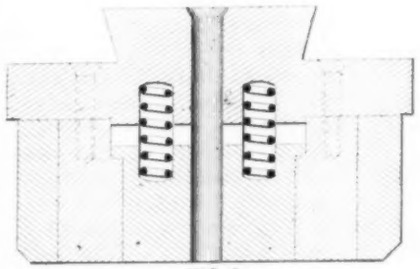


FIG. 3

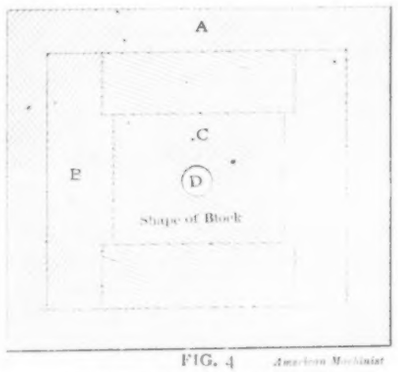


FIG. 4 *American Machinist*

MAKING SLOW WEARING DIES.

die is to be used on gold, silver, or soft thin brass, it will give the best results if the clearance is carried up to the extreme cutting edge of the die, as shown in Fig. 1, the punch being left soft and then set out and shaved into the die every time it is set up. This style of die is used in the jewelry industry, and I know of no class of presswork where it is more essential for the punched blank to be cut free from burr—or barb, as they call it—than in jewelry work. I have seen dies made as described that had been in use years and had trimmed many thousand pieces which had the temper color still on the dies as distinct as when they first left the fire. Of course, a die of this style can be ground a few times and still not change the size of the blank to any great extent.

If the die is to be used on a harder class of stock, such as hard brass, copper or sheet steel, it is better to give it a clearance as shown in Fig. 2 and leave 1/8 to 3/8 inch with just the least clearance, so that it can be ground and still keep the size of the blank intact. A die made in this manner with a well fitted and hardened punch will run 10,000 to 30,000 blanks of plain sheet iron or steel before it requires grinding, and if the press is in good condition it will punch 1,000,000 blanks before it is worn out.

If the work is on scaly, or, as the press hands call it, "dry" stock, it wears out the die very fast, and if there is a large number of the blanks wanted, a compound die like sketch Fig. 3 will give the best results. The first cost will be double that of a plain die, but it will run off ten times the number of blanks, and the last will be as perfect as the first. The die shown was made after five or six of the regular dies had been made and worn out. A plain die was tried with 1 inch of wearing surface; it was a complete failure and the work looked like the leaves that drop off in the fall. The force required to push them through the die put them all out of shape.

The die, Figs. 3 and 4, was then made. It was got out in sections and each piece was hardened and ground to size and then a steel band *A* was got out and machined all over, the inside being left 1-32 inch smaller than the outside of the die, and it was shrunk on after the die was finished. The punch was made of one piece of tool steel and ground up all over after being hardened. It was sub-pressed with four pins, not shown in the cut, and it ran off between three and four million blanks before it was ground up so short that it could not be used.

The shop cost of the die was $58, and the plain dies cost us $18 each, so there was a saving of 25 per cent on the cost of the tools by using the compound die, to say nothing of the extra quality of the work produced.

There was one thing against the compound die; it is next to impossible to make a change in the shape of the blank and not have to make the whole die all over. The superintendent of a large firm in the electrical line told me they never made a compound die for a field or armature sheet until they had built one and run it long enough to be sure no change was wanted, and in all their experimental work he thought it best to "piece out" the first one and not make a die at all.

J. L. LUCAS.

Birmingham, Ala., is to be represented at the St. Louis Exposition by an iron statue of Vulcan, 56 feet high and weighing 100,000 pounds. It was designed by G. Moretti and is composed of fifteen pieces. It will be mounted upon a pedestal of coal in the Palace of Mines and Metallurgy.

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The Poll of the Manufacturers' Association on the Metric System.

As our readers are aware, it has been the object of this journal in connection with the metric agitation to publish the news relating to it and especially to give the opinions and conclusions of those who have used the system in machine construction. The latest news regarding the matter we find in a supplement to *American Industries* giving in tabular form and summary the result of a poll of the members of the National Association of Manufacturers. We will not weary our readers by giving the results in detail, and it is sufficient to say that while some crumbs of comfort may be derived from it by those who believe in the advisability of at least trying to make some progress toward the ultimate adoption of the metric system, the vote is very heavily against it and against the proposed adoption of it by the governmental departments. It includes also a goodly number of manufacturers who say they have had more or less experience in the use of the metric system and who for the most part are as much opposed to it as those who have had no experience with it.

The vote seems to have been based almost entirely upon purely commercial considerations. Rightly or wrongly most manufacturers have arrived at the conclusion that the adoption of the metric system or any step toward such adoption would cost them enormously. In this, as we have said before, we believe they are mistaken. But, on the other hand, when a manufacturer asks what may be gained by the adoption of the system or by the proposed legislation very little that is definite or conclusive can be presented, and the natural thing therefore is to "let well enough alone." Very many of our machinery builders have been large exporters to foreign countries. Almost unanimously they declare that the fact that their machinery is built to the inch-pound system is no hindrance to them in this foreign trade. True there are those who think it will be increasingly disadvantageous as foreign builders bring their products more nearly up to equality in other respects; but the average manufacturer is disposed to cross that bridge when he comes to it, and it is our belief that when the American manufacturer does reach this bridge, if he ever does, he will promptly use the metric system as much as may be called for by the commercial conditions then existing and will probably be surprised to find what a very large proportion of the apparently insurmountable difficulties really amount to almost, if not quite, nothing at all.

Recently we have heard of an American builder who was after an order for a lot of special tools for the Japanese Government. He lost the order to an European competitor and believes it was mainly because the European tools were constructed to the metric system. One swallow does not, however, make a summer, and there will probably have to be quite a lot of similar experience before any appreciable effect is produced upon public opinion. Lacking such experience it is not to be expected that manufacturers will be very enthusiastic about making a change to a system that is unfamiliar to them, and the adoption of which they have been led to believe will be expensive.

As our readers are aware, we regard as of small value the opinions of those who have not used both systems respecting the relative merits of the two systems, but it is nevertheless true that it is the privilege of every American citizen to favor or oppose any public movement whether he understands it or not or whether he has given the matter much or little attention, and it is right that public opinion should rule in this as in other matters.

If, as now seems probable, immediate favorable action upon the pending bill is impossible, it simply means that those other American citizens who do believe in the greater efficiency and general superiority of the metric system must carry on their propaganda longer and perhaps in a different way before tangible results can be hoped for. Whether this will be done or not, we of course cannot say. So far as we know, no one is pecuniarily interested in the work, and there is certainly no politics in it. We should not be surprised to see the whole question subside until some development of international trade makes of it a question that must be met and solved. When that time comes, if it does come, a satisfactory solution will be found and possibly the records of the present discussion will then be of some use; especially the report of the committee of the American Society of Mechanical Engineers, which is a dignified, fair and complete presentation of both sides, and that is much more than can be said for a good deal of the discussion that has taken place.

A Marvelous New Power Plant.

A Bridgeport (Conn.) paper states that the Union Metallic Cartridge Company, of that city, will erect a $75,000 addition to its plant.

Among other noteworthy modern features it is said "the foundation will rest on piling and the building will have a steam chimney 150 feet high with a seven-floor flue and galvanized iron ventilators and skylights." It may now be truly said that we are in the Iron Age, when we find that glass as a material for skylights is a thing of the past, being superseded by "galvanized iron."

The article further states: "An interesting feature of the interior equipment will be the installation of a steel (?) turbine equipment of 3,000 horse-power. The turbine is a reciprocating engine with a piston rod that extends back and forth

instead of in a circle, and is the most modern."

We consider the price, $75,000, for such a novel plant exceedingly low.

Designing the Union Engineering Building.

Six architects have been selected with Prof. W. R. Ware as professional adviser and after a preliminary report a program of competition will be arranged and given out. These architects are to be paid for their designs. Other architects, of course of good standing in the profession, will be invited to enter a free-for-all competition in which four equal prizes will be awarded. Prof. Ware was for several years professor of architecture at the Massachusetts Institute of Technology and later held the same position in Columbia University. He has besides had a wide experience as a professional adviser in large competitions of this character.

American Tools in Japan.

Charles A. Francis, formerly of Hartford, and who is now in Tokyo, Japan, writes that "at the present time the various agencies handling American tools cannot get them here fast enough, and that this year is the best known in the sale of American machinery." He also thinks the American machine builders should make a great effort to increase the trade in Japan for American tools. What is needed is good tools which the makers are willing to stand back of, as there are plenty of cheap tools there now.

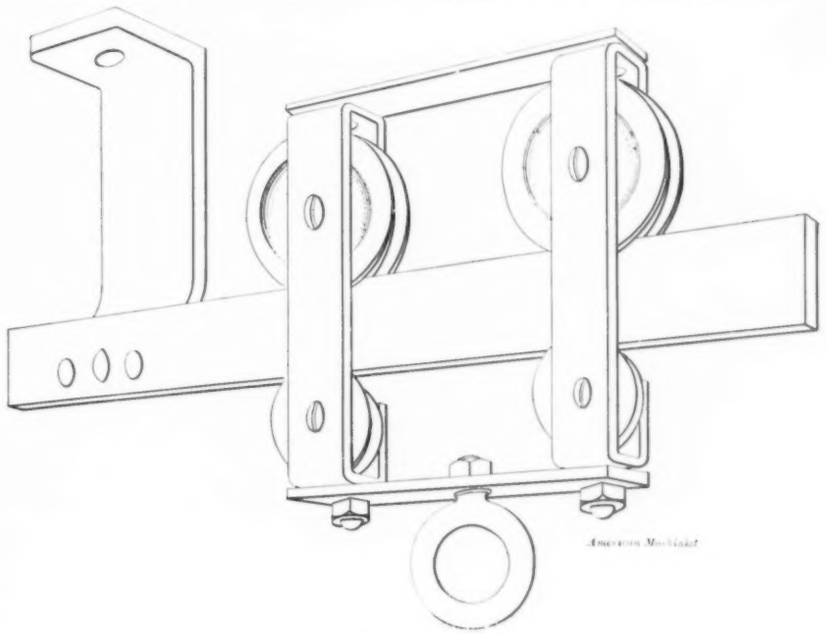
Mr. Francis was invited to a dinner given by eight members of the Shibaura Engineering Works on March 21 at a Japanese hotel—"The Mihorashi." The hosts were all former students of the Tokyo Koto Kogo Gakko, in which school Mr. Francis is an instructor. A very pleasant evening was spent, and with the help of an interpreter Mr. Francis was able to give quite a long and interesting talk on the methods of handling American tools, as well as suggesting some of the various ways in which these tools could be used to better advantage in turning out work in which jigs and special tools were required.

The many Americans who have visited and admired the splendid shops and studied the admirable methods followed by Willans & Robinson at Rugby, England, will regret to hear that their business has of late been on the whole unprofitable and that it has become necessary to readjust their financial affairs on a new basis. General dull business and increasing competition are given as the principal reasons for this untortunate condition. It is to be hoped that they will soon have matters in good shape again, for from the engineering standpoint and as regards quality of product (the Willans Central Valve engine) they stand very high and their establishment is a distinct credit to their country.

Some New Things

FLAT TRACK TROLLEY.

This trolley operates on a rail which, though attached to the brackets by bolts, is actually supported by lugs formed at the bottom of the brackets, these lugs thus relieving the bolts of all strain due to the load. The trolley is equipped with roller bearings and has a pair of wheels at the bottom to prevent it from jumping the track. Track and trolleys can be provided suitable for loads up to 6,000 pounds. The



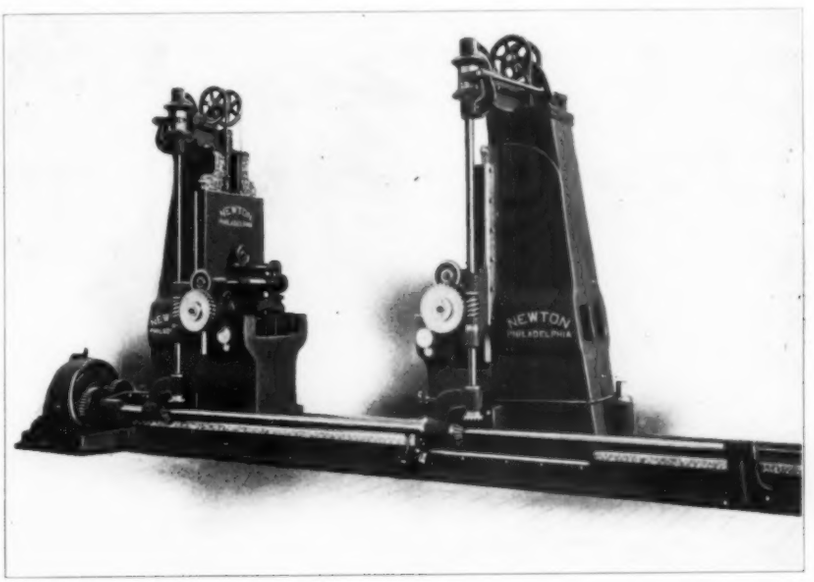
FLAT TRACK TROLLEY.

New Jersey Foundry & Machine Company, 9 Murray street, New York, is the maker.

BRACE MILLING MACHINE.

The accompanying illustration shows a double brace milling machine for squaring the ends of angle-iron braces for structural iron work. It will operate on pieces up to eight inches section and from two to twelve feet long, milling both ends of two angle-iron braces at the same time.

The pieces to be milled are passed through the holes in the column and after milling are passed through corresponding holes in the opposite column. A leg of each angle is dropped between the chuck jaws shown of which the binding screws of both are operated from the working side of the machine through the pinions shown. A clamp above the angles also assists in the binding. The feed of the cutter is obtained from the geared connection to the cutter spindle which operates to turn the long nut within the saddle. There are four changes of feed with automatic throw-out. Quick traverse of the head is obtained by turning the screw



BRACE MILLING MACHINE.

through the gears at the top of the column. The milling cutters are internally lubricated through the hollow arbor and radial holes through arbor and cutters, after the manner which has been illustrated in these columns. The chucks shown are for angle braces only, but it is obviously a simple matter to adapt the machine to work on channels.

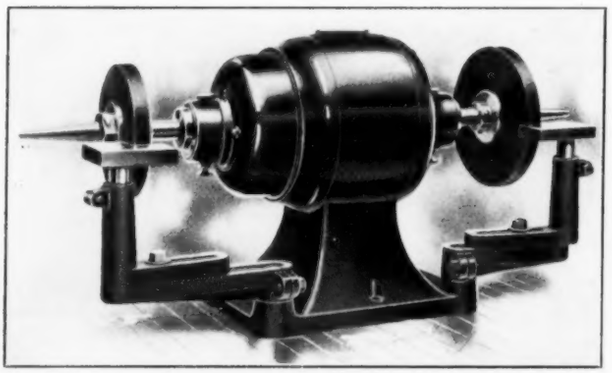


FIG. 1. DIRECT CURRENT GRINDING AND BUFFING MACHINE.

The machine is the product of the Newton Machine Tool Works, of Philadelphia.

ELECTRIC GRINDING AND BUFFING MACHINES.

The accompanying illustrations show two electric grinding and buffing machines which are the product of the Holtzer-Cabot Electric Company, of Brookline, Mass. The machine shown with grinding rests is fitted with a direct-current motor, while the other one has an alternating current motor. Special precautions have been taken to make the motors dustproof. This is very important in motors of this class, as the kind of dirt which comes from the grinding wheel is very harmful when it gets under the brushes of the motor. Rubber cushions are provided at the joints which effectually exclude the dust and grit. The shafts are all made standard and chucks are provided to hold either grinding wheels or buffing wheels or both. It will be noted that the shaft is extended to an unusual length and made unusually heavy, for the purpose of getting the buffing wheel to the bottom of a vessel, such as a pitcher. If a buffing motor only is required, the tool rests are removed, leaving simply the taper chuck to hold the buffing wheel; thus either a single- or double-headed buffer or grinder may be supplied or the motor may be changed from one to the other at will.

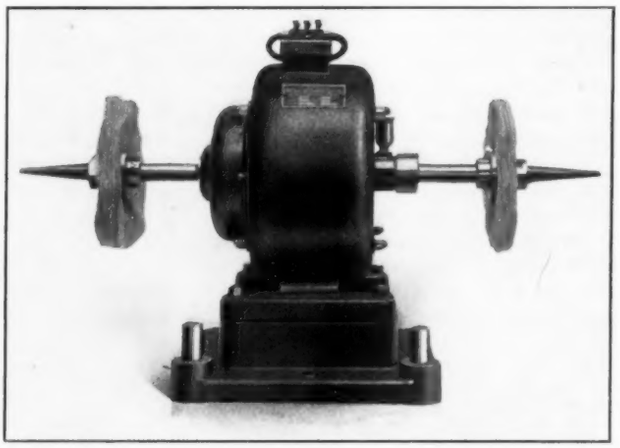


FIG. 2. ALTERNATING CURRENT GRINDING AND BUFFING MACHINE.

A NEW GRINDER.

Mr. R. P. Thompson, of Springfield, Ohio, has designed and built a new grinder which possesses points of novelty and interest, as will be seen from the fact that all three of the views of the machine which we herewith present, besides others we have seen but do not present, were taken without moving the camera, the differences in appearance being due entirely to the facilities offered by the machine for changing to suit different classes of work.

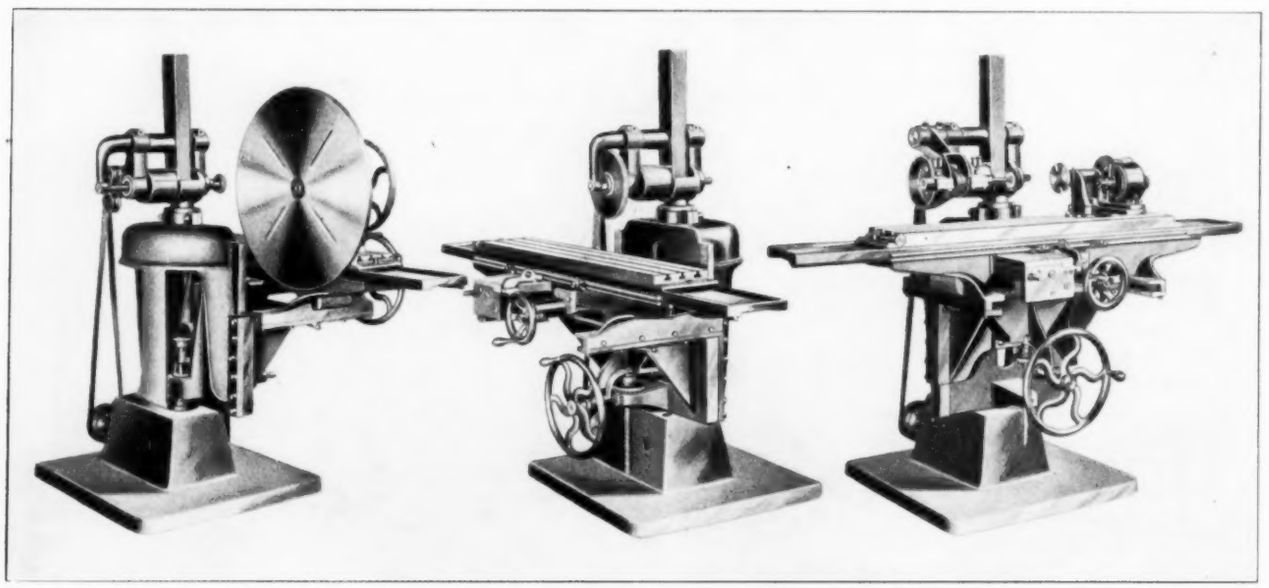


FIG. 1. FIG. 2. FIG. 3.

A NEW GRINDER.

By referring to Fig. 1, which we choose because it gives a view of the arrangement by which the knee and platen can be swung around the column, it will be seen that there is a base and supporting column surmounted by the grinding head, carrying the main grinding spindle. There is also a heavy apron casting, pivotally mounted on the base and having a split bearing at the top, which bearing encircles the neck of the grinding head. Upon the apron is mounted the knee, with a vertical adjustment of 10 inches by means of a screw. An arm extending out from the front of the apron at the bottom carries the nut for the elevating screw, upon which rests the weight of the knee. The knee on its upper face forms a bearing for a saddle which has an in-and-out travel of 8½ inches by means of a screw and hand-wheel. The saddle forms a bearing for the platen, one shear of which is flat and the other a "V."

The platen has a lateral movement of 28 inches, with automatic feed in all posi-

tions. Its top is swiveled at the center and has a screw adjustment and graduations at one end.

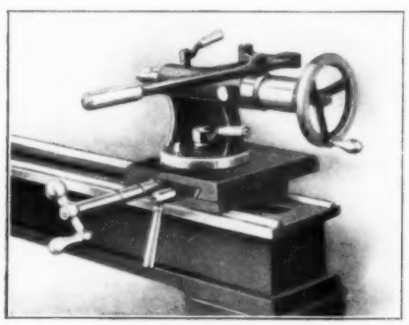
The apron carrying all its parts may be swung from the position shown in Fig. 1 to the position shown in Fig. 2, or 180 degrees. When placed in the desired position the split bearing at top is locked tightly.

Fig. 1 shows the machine as arranged for internal grinding of work mounted upon the large face-plate, while Fig. 2 shows it as adapted for surface grinding, and Fig. 3 with the knee swung to a position intermediate between Figs. 1 and 2, which is the position for all sorts of cylindrical, taper and internal work on centers, or held in the chuck; the internal grinding fixture being here shown in position for use. This internal attachment is supported by an arm clamped to the regular overhead arm, which, as will be seen, is arranged *a la* milling machine and forms an outboard bearing for the main wheel spindle when desired.

In all of the varying positions the feed of the table may be either automatic or by hand. The automatic stops and reverse are positive, and work may be ground close to a shoulder, or to the bottom, if it be internal grinding. By lifting the reversing lever, shown with the ring on its upper edge in Fig. 3, the reverse mechanism is locked out of engagement and the table is free to move by hand. The automatic feed mechanism for the table is driven by belt from the main grinding spindle, so that any variation in speed of grinding wheel has a corresponding variation in the table feed which prevents choking or jamming the wheel. A cone pulley at the base gives variable feed changes, and it will be seen that these features give great range of application to all kinds of work to be ground and to any manner of grinding it that the operator may choose.

IMPROVED SPEED LATHE TAILSTOCK.

The half-tone shows an improved set-over, swivel tailstock specially adapted for speed lathes. The base of the swiveling



IMPROVED SPEED LATHE TAILSTOCK.

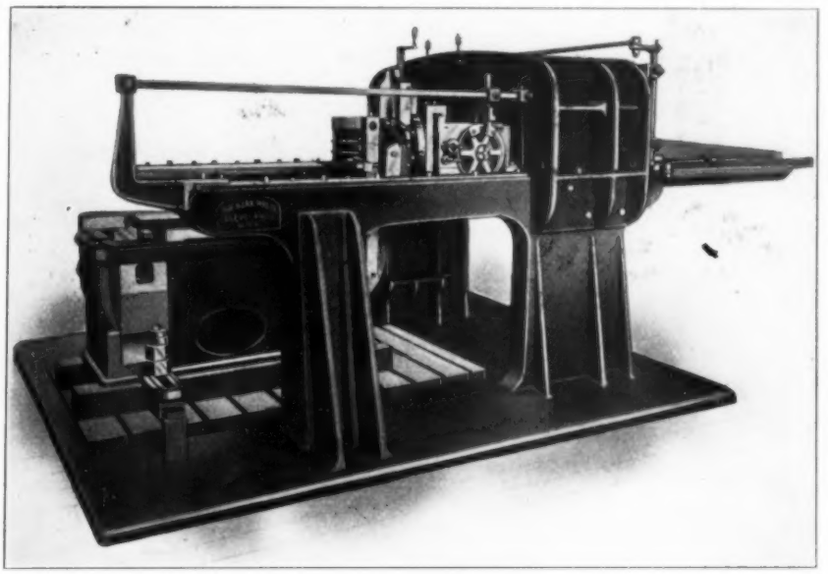
portion is graduated so that it can be set to any angle with accuracy, while a taper pin sets it in line again. The cross-slide is long, overhanging the block and the cross-screw has an extension socket handle, which gives a long set-over in either direction. The spindle has both wheel and lever feed. When using the lever the thumb-screws both at the front and back are loosened. A hole may be drilled by feeding with the hand-wheel until the proper depth is reached, and then by clamping the hand-wheel nut subsequent holes may be drilled to the same depth by the use of the lever, and other operations may be gaged in the same way. When not in use the lever may be removed. The handle for clamping the tailstock to the bed is at the side. This tailstock is furnished on a speed lathe built by J. G. Blount & Co., Everett, Mass.

A NEW SPECIAL PLANER FOR LARGE WORK.

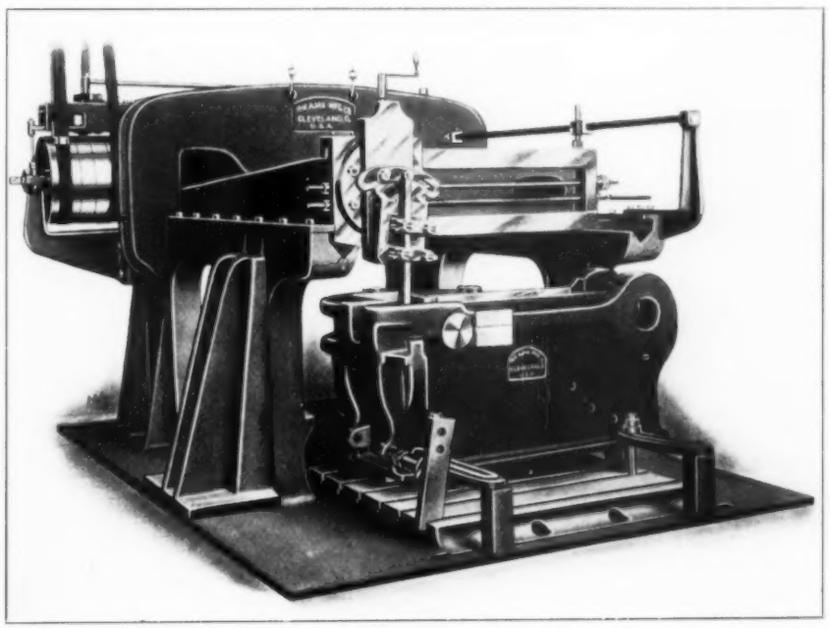
The planer illustrated corresponds in size to an ordinary 60x60-inch planer; it was built about three years ago to handle heavy work.

As the head is the only part to be moved (the heavy pieces to be planed being secured to the stationary bed), the power necessary to move it at a given speed remains constant, the weight of the piece being worked, of course not affecting it.

The planer is driven by a rack and pinion 8½ inches face cut 2½ diametral pitch. The width of the driving belt is 3 inches, and the cutting speed of the tool is 40 feet per minute; the speed of the belt on the cutting stroke is 1,019 feet per minute, the return is 45 feet per minute, and the speed of the belt on the return is 1,148 feet per minute. The maximum up-and-down feed is ⅛ inch per stroke, and the cross-feed



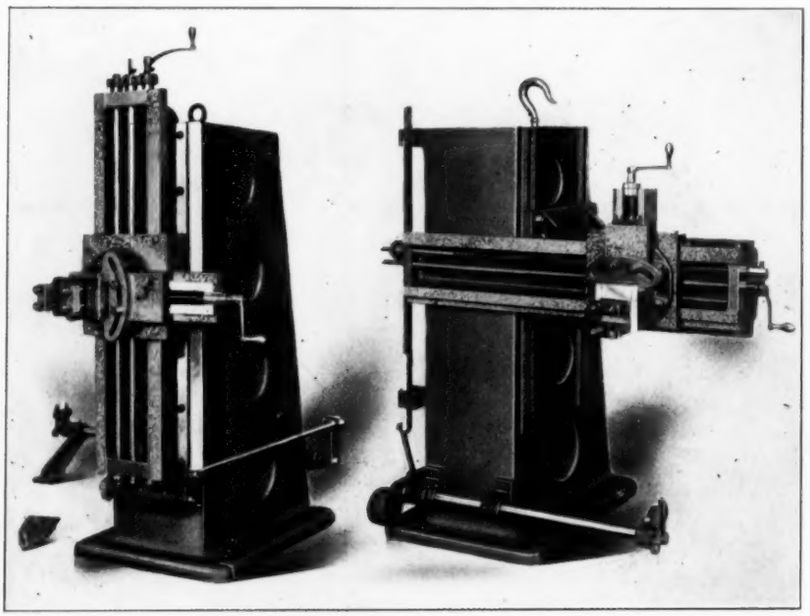
A SPECIAL PLANER FOR LARGE WORK.



A SPECIAL PLANER FOR LARGE WORK.

¼ inch. At the speed mentioned the planer can be reversed in a travel of less than one inch.

These planers are built in various sizes by the Ajax Manufacturing Company,



INDEPENDENT PLANER HOUSINGS.

Cleveland, Ohio, who have several of them in use in their own shops.

INDEPENDENT PLANER HOUSINGS.

For planing castings which are so large as to be beyond the capacity of their widest planers, the G. A. Gray Company, of Cincinnati, Ohio, build two types of independent housings to be used in connection with floor plates at the side of the machine. The housing in Fig. 1 is adapted especially for vertical cuts; that in Fig. 2 for horizontal planing. By means of bolts dropped in the T-slots in the floor plate the uprights or columns, each with its rail and head, are fastened rigidly in the required position near the side of the platen, the work being mounted on the planer in the usual manner. The heads are fed automatically through the action of the projecting rock shaft at the foot of either housing, the trips at the ends of the shafts being actuated by the regular dogs on the platen. Both housings are provided with independent rail adjustment, so that the rail may be square with the planer table even though the floor plate is not exactly level. To facilitate handling by the crane, an eye-bolt or hook is provided at the top of each housing. The vertical travel of the head on the column shown in Fig. 1 is 45 inches; the angular feed is 15 inches. The head in Fig. 2 feeds 42 inches on the rail and extends 32 inches from the column when in its extreme outer position. Its angular feed is 8½ inches. The rail or arm has a vertical adjustment of 30 inches. The weight of this housing is 4,500 pounds; the one for vertical planing weighs 4,000 pounds.

VERTICAL MILLER AND SLOTTER.

The engravings illustrate the vertical spindle milling machine and slotter built in two sizes by R. M. Clough, of Tolland, Conn.; the tool shown, which is the larger size, having a table 28x9¾ inches, with power feed longitudinally of 21 inches and cross movement of 9 inches. The slotting attachment is clearly shown in the line engraving, and it will be noticed that the drive for the worm-wheel for reciprocating the ram is from a worm on the miller spindle, the ratio between worm and gear being such that 12 turns of the spindle give one complete ram stroke. The stroke is 4¾ inches and the cutting speed of the tool ranges from 6 to 30 feet per minute. An important feature of the slotter is the

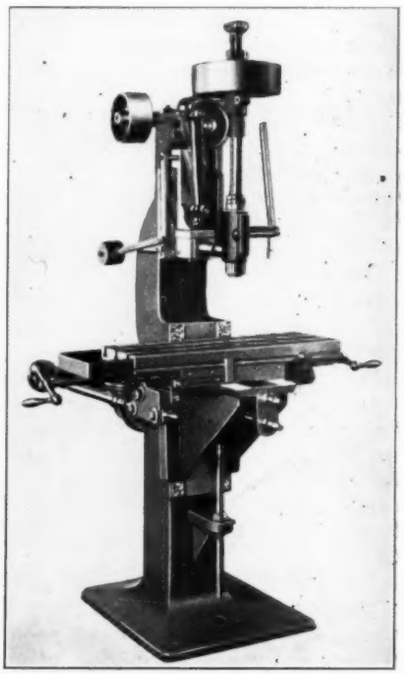


FIG. 1. VERTICAL MILLER AND SLOTTER.

tool block or clapper which has relief motion on the up stroke and can be swiveled so as to allow the tool to cut either crosswise or lengthwise of the table. The toolpost takes ⅝x1-inch steel. The ram is well balanced in the manner indicated in

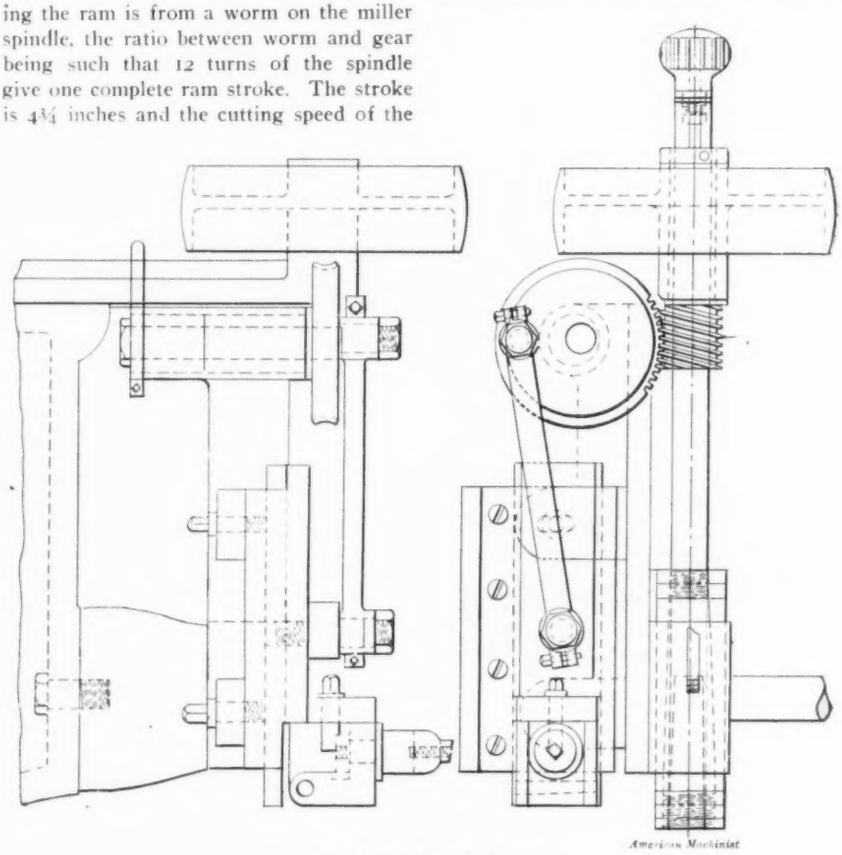


FIG. 2. SLOTTING ATTACHMENT.

the half-tone. The attachment may be thrown into or out of gear quickly, and when not in use interferes in no way with milling or drilling operations.

The miller spindle has a B. & S. No. 10 taper hole, and carries at the upper end a 10x2¾-inch driving pulley. At the front of the column a gap 4 inches deep by 6 inches high is formed, giving a swing of

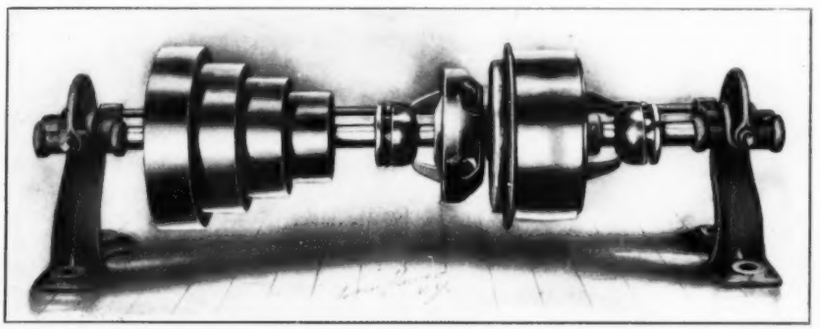


FIG. 1. SMITH SINGLE BELT REVERSING COUNTERSHAFT.

26 inches from center of spindle. The knee has a vertical adjustment of 15 inches. The countershaft is equipped with double friction pulleys 12 inches diameter for 3½-inch belt and drives the spindle at six rates of speed ranging from 100 to 500 turns per minute. The machine weighs about 1,500 pounds.

THE SMITH SINGLE BELT REVERSING COUNTERSHAFT.

The countershaft here shown possesses the desirable feature of running in either direction, as required, with but a single belt to drive it. Not only is the other belt permanently dispensed with, but the pull of it upon both line shaft and counter-

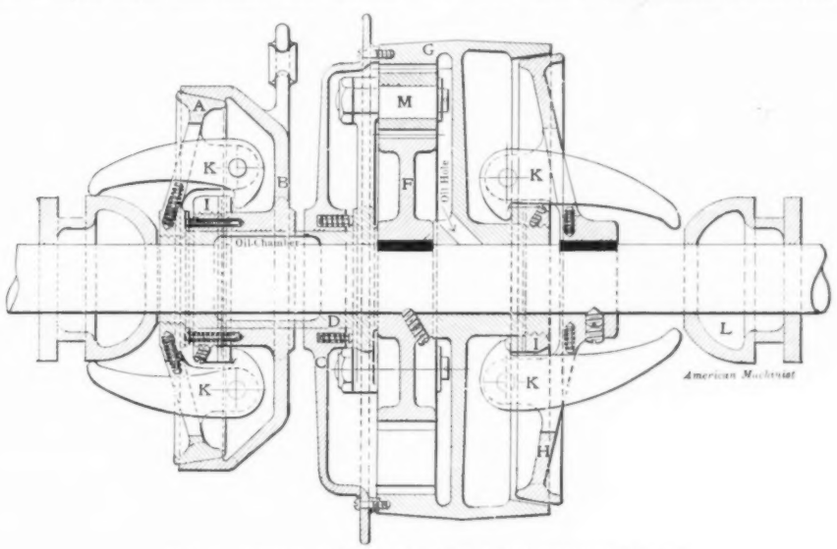
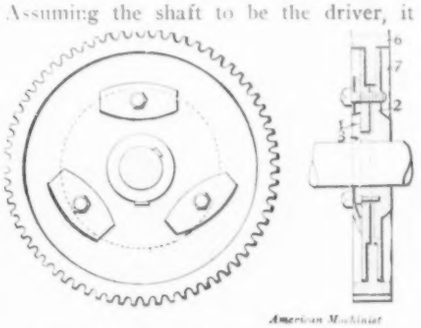


FIG. 2. SMITH SINGLE BELT REVERSING COUNTERSHAFT.

bearings is also eliminated by the adoption of this device. The additional advantage to be mentioned is that the reverse speed may be greater or, by special arrangement, the same as the direct drive. Fig. 1 shows a countershaft complete, and Fig. 2 gives the parts in section so that their operation may be easily understood. The pulley *G*, which carries the driving belt, runs loose upon the shaft. It has an internal conical surface at its right-hand edge, into which fits the external cone *H*, which is feathered to the shaft, and when this cone is forced into contact by the levers *K* distended by the conical collar *I*, the shaft is driven in the same direction and at the same speed as the pulley. At the other edge of the pulley is fastened the case or cover *C* the hub of which runs freely on the long sleeve *D*, this bearing thus becoming an important steadying addition to the hub bearing of pulley *G*. The pulley at this edge has internal gear teeth which mesh into three equidistant pinions *E*, which in turn mesh into and drive gear *F*, which is keyed to the shaft. The pinions *E* run upon studs in the spider which is cast on the end of sleeve *D*. *B* rides loosely upon sleeve *D*. It has a projecting arm by which it is always kept from rotating, and it has also the internal conical surface into which fits the external cone *A*. This cone *A* is feathered to the outer end of sleeve *D*, and when, by the operation of the levers, *A* and *B* are frictionally locked together, sleeve *D* with its pinion-carrying spider is held from rotating, and then gear *F* and the shaft to which it is keyed are rotated in the reverse direction. The chamber in the pulley formed by the cover *C* provides an excellent opportunity for constant lubrication, and the pulley runs for a long time without attention. It is stated that it will not throw oil. The countershaft is made in several regular sizes and also to special dimensions, as required, by the Smith Countershaft Company, Melrose, Mass.

ADJUSTABLE FRICTION DRIVE.

The cut shows a simple adjustable friction drive, the subject of a recent patent. Assuming the shaft to be the driver, it

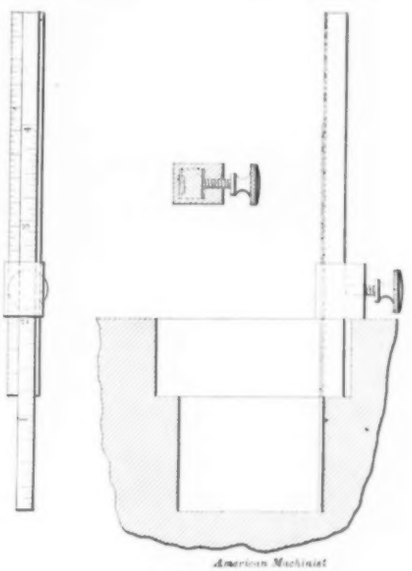


A SIMPLE ADJUSTABLE FRICTION DRIVE.

has keyed upon it a hub 3 which carries integral with it a disk 2 with a thinner part 7 at its periphery. Upon the hub 3 is feathered a similar disk 1 facing the opposite way, and these disks clasp between them the inwardly extending flange of the gear 6 which is to be driven. The pressure is adjusted as desired by the three cap-screws acting upon the springs, as shown. Instead of the gear, a pulley or any other wheel rim may of course be driven.

DEPTH GAGE.

The tool in the accompanying cut consists, as shown, of two narrow scales, one



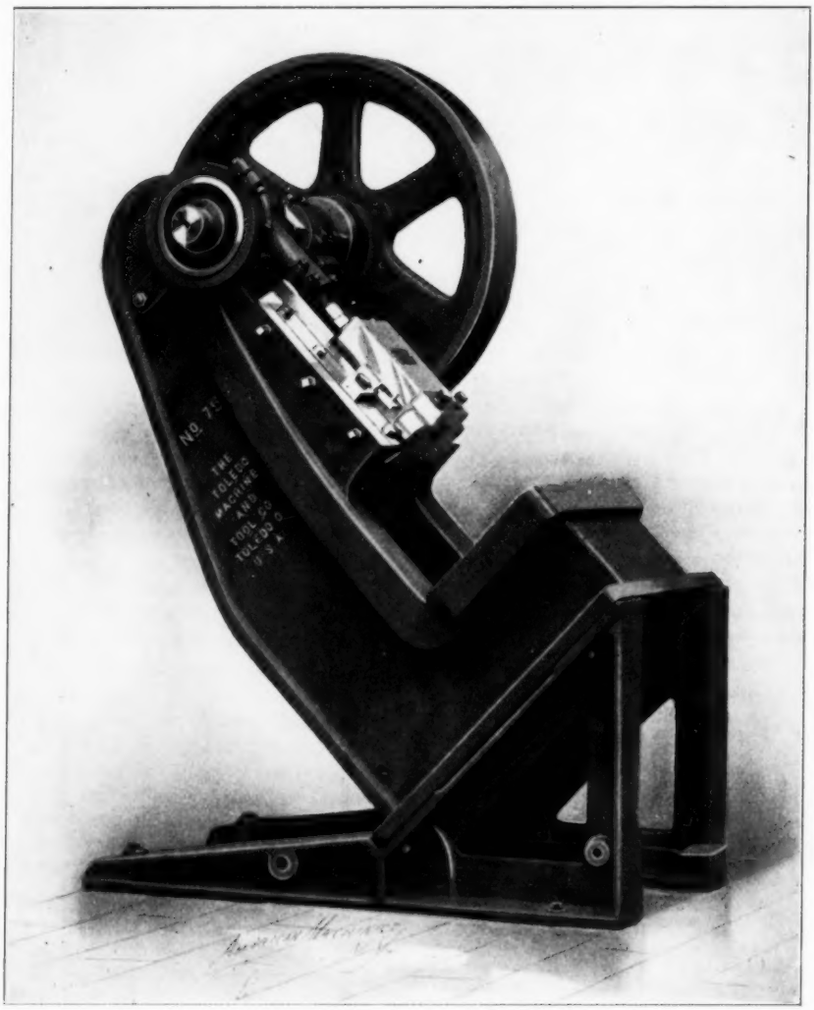
DEPTH GAGE.

of which slides in a longitudinal groove formed in the face of the other. The body or heavier scale carries a sliding clamp by which the two graduated members are fastened together after they are properly adjusted. The gage is of course adapted for measuring the depth of holes and for various other purposes. Its use in gaging

a counterbored hole is clearly shown, the depth of both the enlarged portion and the smaller hole being obtained simultaneously. William J. Gillard, 2008 Sixteenth avenue, Minneapolis, Minn., is the patentee of the device.

AN INCLINED, OPEN BACK POWER PRESS.

The half-tone shows one of the latest of this important type of press, for which there is now an extensive field of service. These presses are used for deep forming and reducing on stamped ware, punching, shearing and perforating, also cutting, stamping and embossing tops and bottoms



INCLINED OPEN BACK POWER PRESS.

of meat, varnish and petroleum cans in one or more operations, operating large blanking and combination dies, etc. The inclined position for the presses as here shown is preferable where it is desired to let the work fall off by its own weight. The same press is made mounted vertically upon a stand of suitable hight and is also made with gear drive, the latter being recommended where a slower movement of the ram is desired. The press has an increased bed area and hight of die space, and modifications can be made to order for special work. The area of the bed is 14x23 inches, and the distance from the bed to the bottom of the slide, stroke and adjustment up, is 10 inches. The balance wheel is 30x5½ inches and weighs 450 pounds. When the machine is geared the ratio is 6½ to 1 and the diameter of the gear is 35 inches. The gear and pinion are machine cut from a dense grade of special steel. The shaft has phosphor bronze bearings. A new form of positive knockout in the slide is provided operated by positive stops with screw adjustment. It is adjustable from the front of the slide and can be operated by a cam-actuated movement direct from the crankshaft when required for special work. The slide adjustment is unusually long and the clamping or locking device is claimed to be the most effective in use, as the slide adjustment or pitman screws are clamped by a cap which bears squarely and directly on the screw threads, the clamp never working loose. The press is made in several sizes, that here shown being called No. 75. The weight as shown is 3,800 pounds, and when geared the press weighs 4,400 pounds. Made by the Toledo Machine & Tool Company, Toledo, Ohio.

We find that the device illustrated by us at page 465, being a movable index for a micrometer caliper, is the subject of a patent issued to W. D. Turner, of Providence, R. I., which patent was issued the day after the receipt of the article by us.

Walter A. Rosenbaum, of 35 Broad street, New York, has applied hydraulic power to a letter press such as is used in business offices. He places two cylinders below the lower platen and by turning a cock water pressure is admitted to these cylinders and the screw to be worked by the office boy is done away with.

The Southern Supply & Machinery Dealers' Association at a recent meeting adopted a resolution in favor of a standard size for pamphlets, leaflets, etc., issued by dealers. No specific size was given for this, but we hope that if such a standard is adopted it will conform to the sizes for such things that have already been adopted by the Engineering Societies and the American Society of Master Mechanics, etc., namely, 6x9 or 9x12.

The eighth annual convention of the American Cotton Manufacturers' Association is to be held at the Arlington Hotel, Washington, D. C., May 11 and 12. The following are among the topical addresses: Prof. R. C. Carpenter, Cornell University, "The Cost of Power"; F. H. Newell, Chief Engineer, U. S. Geological Survey, "Forests and Water Powers"; Frederic S. Green, American Manufacturing Company, New York, "Rope Transmission of Power."

A Veteran Engineer and His Work.

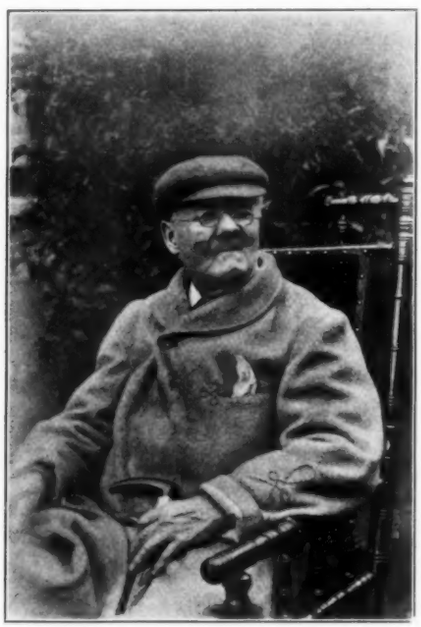
BY JAMES VOSE.

In the person of Mr. Joseph Howard, of Manchester, England, recently passed away a veteran designer, constructor and manager whom all possessing his acquaintance or friendship delighted to honor. At the age of eighty, he was intellectually alert and incisive in his observations on current engineering topics, and scarcely a week-end passed without his being the referee of an informal gathering of mechanics of all ages and positions. At one period, in the capacity of patent office draftsman, he came into direct and intimate contact with men of the calibre of Bodmer, Richard Roberts, Whitworth, Fairbairn, Nasmyth, etc., and his reminiscences of the characteristics and doings of these pioneers it was a privilege to listen to.

A prized possession of his was a set of drawing instruments once the property of Bodmer, which narrowly escaped being swept away, along with the office Mr. Howard was then employed in, at Sheffield, by what is still known as "the great flood," caused by the bursting of a large reservoir on the hilly outskirts of the town.

A story he sometimes related was to the effect that he once received, boxed up from Germany, one of the original Otto gas engines, forwarded by the inventor to Mr. Howard as manager for Messrs. Butterworth, of Manchester, with a view to

the engine being manufactured in England. He considered his firm had more important matters to attend to at the time, and returned the case without even opening it. Eventually the manufacture of the engine was taken up by Messrs. Crossley Bros., of Manchester, a highly successful business being developed. When Mr. Howard retired into private life Messrs. Butterworth gave up their toolmaking business, and it is a curious fact that at the sale of the firm's effects some of the old tools in use sold at a higher price than new tools of the same description stocked in the showroom, the purchasers evidently being under the impression that the old machines must be "master tools" to have produced such satisfactory tools as Messrs. Butterworth were generally credited with turning out. In conclusion, as showing the range of experience formerly often called



JOSEPH HOWARD, OF MANCHESTER.

for, Mr. Howard had been concerned in designing such varied productions as public clocks, factory chimneys, highly sensitive engine governors, cotton machinery and special machine tools, and, in the civil engineering department, he had devised schemes for river flood prevention and kindred works.

Inquiry for Machinery.

(177) The following inquiry has been received at this office: "We shall be glad to hear from any of your readers who can offer us machinery for producing twist drills and taps—especially with regard to fluting twist drills."

Personal.

G. M. Richmond has been elected vice-president of the American Emery Wheel Works, Providence, R. I., and H. A. Richmond has been appointed superintendent in place of W. D. Allen.

Lewis F. Lyne, who in the early days was one of the editors of this paper, has opened an office, as consulting engineer, at 10 Barclay street, New York. He makes a specialty of power-plant matters, and is agent for several specialties.

David J. Havenstrite, until recently head of the Havenstrite Engineering Company, has joined the staff of the Engineering Company of America and will continue to devote his attention to his specialty, which is ice-making and refrigeration plants.

Frederick G. Lynn, who was formerly in the Niles Tool Works shops at Hamilton but has for some time been in charge of the lathe job at the Pond Machine Tool shops at Plainfield, N. J., has been made superintendent of the last-named shops.

Obituary.

John McCray, foreman for many years of the boiler shops of Robert Wetherill & Co., Chester, Pa., died April 16, sixty years old.

Amos K. Tappan, manufacturer of steam pumps at 105 South Canal street, Chicago, died April 10. He had been in the same business twenty-five years.

Charles Henry Perkins died at Providence R. I., April 2, seventy-four years old. Mr. Perkins was born in Taunton, Mass., had a common school education, learned both the blacksmith and machinist trades and for ten years had charge of the repairs of cotton-mill machinery. He invented a machine for making horseshoes in 1857, and a year or two later formed the partnership of Cutter & Perkins, of Providence, out of which grew the Union Horse Shoe Company, which made many horseshoes for the Union Army during the Civil War. Before the war ended Mr. Perkins established the Perkins Sheet Iron Company, which rolled the first Russia iron made in this country. This business was not successful, and out of it grew the Rhode Island Horseshoe Company, a part of the vast industries of A. & M. Sprague, which included the Sprague Mowing Company and the Comstock Foundry Company, Mr. Perkins becoming manager of the whole. After the Sprague failure the Rhode Island Perkins Horse-Shoe Company was reorganized and Mr. Perkins was its general manager up to the time of his death.

Business Items.

The Auburn Ball Bearing Company has removed its main offices and factory from Auburn, N. Y., to 18 Commercial street, Rochester, N. Y.

The Lunkenheimer Company, Cincinnati, Ohio, has gotten out a very neat hanger, lithographed on tin, which it is sending out to dealers handling its goods.

The Ramsey & Thornley Machine Company, 51 Godwin street, Paterson, N. J., has been organized by C. H. Ramsey and Edward Thornley for the purpose of doing general machine work and the designing and building of special machinery.

Patterson, Gottfried & Hunter, Limited, of 146-150 Centre street, New York, have undertaken the sole distributing agency throughout New York, New England and northern New Jersey, of the American Pioneer steel shaft hanger.

The Wells Brothers Company, Greenfield, Mass., has gotten out a very neat and attractive catalog cabinet, containing about forty of its latest illustrated catalogs, in which are illustrated and priced a line of screw cutting tools and machinery. These cabinets are sent out to the dealers free, and are used for general distribution among its customers.

The Rand Drill Company, of New York, has just installed two compressed air plants for the United States Government—one at Fort Stevens, Ore., and one at Tuscaloosa, Ala. At Fort Stevens the equipment consists of one Rand "Imperial" type 10 air compressor, having duplex steam cylinders 7 inches in diameter and compound air cylinders 10 and 6½ inches diameter with 8 inches stroke, several "Imperial" pneumatic riveting hammers and calking hammers and piston air drills. It is understood that the plant will be used for the improvement of the mouth of the Columbia River. The Tuscaloosa equipment consists of one Rand, 8x8x12, Class C, straight-line, steam-driven air compressor; a number of "Imperial" pneumatic long-stroke riveting hammers and "Imperial" piston air drills.

Manufacturers.

The Botany Worsted Mills, Passaic, N. J., plan to erect a big additional plant.

The Union Electric Company, Dubuque, Ia., proposes to build a new power-house.

The Lewis Spring & Axle Company, Jackson, Mich., has lately undergone a fire.

The factory of the Empire Furniture Company, Jamestown, N. Y., has been burned.

The Diebold Safe & Lock Company, of Canton, O., will build a $15,000 addition.

The large shoe factory at Brockton, Mass., of L. M. Reynolds & Co., has been burned.

The Moses Dillon Company, Sterling, Ill., will enlarge its door and sash department.

A four-story, 32x200-foot addition is to be built for the Bridgeport (Conn.) Brass Company.

The Keystone (Wire) Fence Company, at Bartonville, Peoria, Ill., will enlarge its plant.

Ground has been broken for an addition to the plant of the Bridgeport (Conn.) Crucible Company.

The foundry of P. J. Clarke & Co., Tifton, Ga., has been burned. The machine shops were saved.

The plant of the American Ship Windlass Company, Providence, R. I., has been damaged by fire.

Fire has damaged the plant of T. A. Wadsworth, Detroit, Mich., known as the Western Cigar Box Factory.

The Rothsville Cement Company, recently incorporated, contemplates building a plant near Rothsville, Pa.

The plant of the Bryan Pottery Company, about three miles east of Trenton, N. J., has been damaged by fire.

An extension will be built to the Glens Falls (N. Y.) mill of the International Paper Company, New York city.

The Furniture City Brewing Company has recently been organized in Grand Rapids, Mich. It expects to build.

There will be a large extension made to the Detroit, Mich., plant of the Chicago Pneumatic Tool Company.

An electric lighting plant in the Municipal

Building, Binghamton, N. Y., is under discussion by the city fathers.

Wm. B. Bertels, Son & Co., manufacturers of tinware, Wilkesbarre, Pa., are to erect one or more new buildings.

Plans are being considered for an addition to the works of the Goodyear Rubber Company, at Middletown, Conn.

It is said that the Eureka Stave & Heading Company, Chicago, Ill., will erect a finished barrel plant at Hope, Ark.

The box department and machine shop of the Lancaster, Pa., plant of the Pennsylvania Soap Company have been burned.

The Detroit (Mich.) Timber & Lumber Company expects to erect a big sawmill plant in Arkansas in the vicinity of Little Rock.

The contract has been let for the erection of a machine shop addition, 70x90 feet, for the Oneida (N. Y.) Steel Pulley Company.

A $40,000 canning factory will be erected at Whiteland, Ind., by Grafton Johnson, who has interests at Greenwood and elsewhere.

The Hawkins Company, South Britain, Conn., manufacturer of tacks and animal traps, is building an addition to its factory.

A glass bottle factory for Pine Hill, N. Y., is under contemplation by E. C. Clifford, of the Pine Hill Crystal Spring Water Company.

J. H. Quast & Co., manufacturers of shoes, Louisville, Ky., have under consideration plans for the construction of a large factory.

The Lanford Oil Mill has been organized at Lanford, S. C., with J. H. Fleming, of that place, president. It will be of 15-ton capacity.

A large, four-story factory building in Camden, N. J., of the Victor Talking Machine Company, Philadelphia, has been burned.

The Continental Tobacco Company New York city, is reported to be making arrangements to establish a large plant at Cincinnati, O.

H. W. Bagg and associates of Chattanooga, Tenn., will construct a plant to manufacture spokes and handles. Forty-five men will be employed.

The Norfolk (Conn.) & New Brunswick (N. J.) Hosiery Company has purchased land in Frankford, Philadelphia, and will erect a three-story mill.

The Parkersburg, W. Va., power plant of the Parkersburg, Marietta & Inter-Urban Railroad Company is to have a steam turbine and dynamo.

The explosion of an agitator at the No. 3 refinery of the Gulf Refining Company at Port Arthur, Tex., has resulted in considerable damage by fire.

The H. N. Thayer Company, manufacturer of children's carriages, Erie, Pa., has taken out permits for a building, four stories, 124x244 feet, and an engine-room.

The Orange Grove flour mills of the C. A. Gambrill Manufacturing Company, of Baltimore, Md., and elsewhere, are about to undergo extensive improvements.

The Hotaling-Warner Company, Syracuse, N. Y., manufacturer of macaroni, etc., is about to erect a four-story building, 50x200 feet, to be equipped with machinery.

The Richmond Hosiery Mills will erect an addition to their Rossville, Ga., plant. The hosiery output will be enlarged, and they will install a box-manufacturing plant.

The John Peck Company, Sterling, Ill., will build a 160x50-foot, two-story building for sawing out and possibly turning gun stocks and making novelties from the waste.

It is stated at Lansing, Mich., that plans are being made by Architect D. B. Moon for the first of the buildings to be erected for the manufacture of peat at the Old Maid Swamp.

W. E. Ambler, of the Curtiss-Ambler Realty Company, Cleveland, O., has secured a ninety-nine-year lease on property where a large manufacturing building will probably be erected.

A. K. McLean, of Cheboygan, Mich., and Robert A. Sibbitt, of Ottawa, Can., expect to establish a turpentine factory at Hinckley, Minn., and extract the merchantable properties of pine stumps.

The H. T. Paiste Company, manufacturer of electrical specialties, Philadelphia, Pa., has had plans prepared for a four-story factory building to cost $30,000 at Thirty-second and Arch streets.

Land at Moline, Ill., has been sold to the Walter Mills Company, of Chicago, for a wood-working plant, it is said. The Moline Business Men's Association was active in bringing about the deal.

The Cortland Silk Manufacturing Company has been incorporated, and a fifty-loom plant is proposed for Cortland, N. Y., by Martin B. Casey and Neil P. McTague, of Scranton, Pa., and others.

The annual meeting of the stockholders of the Joseph Dixon Crucible Company, Jersey City, N. J., was held April 18. The old directors were re-elected, and they in turn re-elected the former officers.

The Domestic Engine Works, of Hagerstown, Md., and the Etter Pump Company, of Greencastle, Pa., will build a plant at Shippensburg, Pa. The new concern will be chartered at $50,000 capitalization.

The firm, C. Olivetti & Co., manufacturers of electrical instruments, has removed its establishment from Ivrea to Milan, Italy, where it has increased facilities. Its office address is now Via Broggi, 4, Milan.

Work was commenced on the new plant of the Bancroft Peat Fuel & Cement Company, a mile south of Bancroft, Mich. It is expected that the company will be manufacturing fuel in time for the coming winter's trade.

The Pennsylvania Railroad Company will erect a four-story building for the frame and driving-box departments of the Altoona shops. It will house two other departments to be decided later. The structure will cost $100,000.

Work has been commenced on a two-story, 120x150-foot addition to the plant of the Chattanooga (Tenn.) Roofing & Foundry Company, to be occupied chiefly by the wrought-iron department. The machinery will be electrically driven.

The West Side Electric Power & Lighting Company has been organized at Manitowoc, Wis., with a capital of $25,000, William Rahr, Olga Rahr and William Rahr, Jr., being the organizers. The company proposes to equip an electric lighting plant.

For the purpose of treating Fuller's earth Dr. N. K. Morris and Frank A. Knight will erect a mill at or near Denver, Colo. The cost, it is stated, will be about $100,000. They will treat the output of a ranch they recently leased, a few miles from Akron, Colo.

The Snyder Automatic Signal Company has been formed, to make a railway signal alarm patented by D. M. Snyder, of Abingdon, Ill. He is president; G. K. Slough, vice-president, and F. S. Marshall, secretary-treasurer; capital stock, $20,000. The factory will be at Abingdon.

The Bundy Recording Company, Syracuse, N. Y., has decided to erect a three-story building for offices, model and drafting rooms. The part of the plant now used for those purposes will be made part of the factory. The company has just placed an order for new machinery.

Bullard-Wheeler Company, of Battle Creek, Mich., maker of iron beds, is to locate at Kalamazoo in the old Blakeslee factory building. About forty men will be employed. The offices of the concern will remain in Battle Creek until the company is fully established at Kalamazoo.

The Board of Trade, Ashville, N. C., has received a proposition submitted by Capt. W. T. Weaver, of that city, from Messrs. Lucas, Long and Sirins, of Laurens [S. C.], who propose to erect a $450,000 cotton mill in or near Asheville, provided $120,000 worth of local subscriptions can be secured.

A site is said to have been purchased for a car repair plant to be erected by the Ontario & Western Railroad Company at Mayfield Yards, near Carbondale, Pa., to employ some 300 men. It is rumored that the company has purchased additional land on which it may build a plant for the repair of locomotives.

M. E. True, formerly of Batavia, N. Y., who owns a sawmill at the Papermill, northwest of East Pembroke, will tear down the present building and will replace it with a two-story structure, 42x100 feet. Part of his work will be to make a new style saw handle, also potato crates. He has a water wheel for power.

A stock company composed of Richmond, Ind., men is being organized to manufacture steel step ladders, steel grill work and other steel novelties. The company will have a paid-up capital of $50,000 and establish a factory there. Among those interested are Howard Campbell, Sharon E. Jones and Samuel Gaar.

The plant of the Carterville Lead Smelting Company (address presumably Carterville, Mo.), recently burned, will be rebuilt and several improvements added. Electric motors will be used for operating the grinding machinery and blowers, power being secured from the plant of the Missouri Zinc Fields Company.

Wm. H. Fisher has resigned the position of foreman in the Utica (N. Y.) Pipe Foundry, held by him many years, to engage in a similar enterprise himself. He thinks of erecting a factory building at the corner of Broad and Gilbert streets for the manufacture of a pipe specialty. His address is 66 Jefferson avenue, Utica.

At a meeting of the Board of Trade, Epping, N. H., it was voted to raise money to build a box shop. One department will be 40x180 feet; another, 40x80 feet, with additional boiler-house and engine-room. The committee appointed to supervise the work is Dr. A. W. Mitchell, John Leddy, George H. Macauley and John S. Ladd.

There is a rumor in Denver, Colo., founded largely on conjecture, but apparently with some basis, that the Gould-Rockefeller combination, which, it is said, controls the Colorado Fuel & Iron Company, is preparing to extend its scope on a large scale, and by the erection of new plants to control the Western and Oriental trade in steel products.

Valdosta, Ga., is acquiring two plants for extracting turpentine from lightwood knots and stumps, etc. One of them is to be established by the American Turpentine Company, of Washington, D. C., which has a Southern branch office at Valdosta. It is the Gideon steam process. The Pittman system has an experimental plant about ready for work.

For some months there has been a movement at Anderson, Ind., for the location of a large watch factory. J. H. Kemp, a representative of the company, was recently there, and it was reported that a deal would be closed shortly with the Anderson Commercial Club. The company would take 160 acres of ground for the plant and employ 2,000 men.